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A SIMULATION STUDY OF THE POTENTIAL EFFECTS OF ROLE CONFLICT ON THE POST-ATTACK LABOR FORCE

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June 1969

HSR-RR-69/3-Se IV

Prepared for:

Behavioral Sciences Division
Air Force Office of Scientific Research
Air Research and Development Command

under

AFOSR Contract No. AF 49(638)-549
Project No. 9779-01

Prepared by:

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PREFACE

This is the fourth and last Technical Note prepared on a research project aimed at studying the feasibility of developing an analytic model which would permit integrating the major physical and social effects of a nuclear attack on a modern industrialized society. The study was conducted for the Behavioral Sciences Division of the Air Force Office of Scientific Research, Air Research and Development Command, under AFOSR Contract No. AF 49(638)-549.

The first Technical Note[1] of the series presented abstracts, annotations, and bibliographic references of the background materials providing information inputs to the research program.

The second Technical Note[2] presented the substantive and methodological concepts judged to be of promise in approaching the complex research problems involved.

Two conclusions became increasingly clear as the work continued:

(1) While the development of a model of society appeared to be possible, the effort required by that task was likely to be greater by many orders of magnitude than that assumed at the beginning of the project.

(2) While there appeared to be adequate information on physical effects of bomb damage of all types, the information available on social and psychological effects was totally inadequate for use in the development of a model of the scope originally envisioned.

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[1] R.D. Popper & W.A. Lybrand. An Inventory of Selected Source Materials Relevant to Integration of Physical and Social Effects of Air Attack (Arlington, Va.: Human Sciences Research, Inc., October, 1960, HSR-RR-60/4-Se, AD 244 888).

[2] W.A. Lybrand. Outline of an Analytic Approach to Predicting Societal Recovery from Air Attack (Arlington, Va.: Human Sciences Research, Inc., March, 1961, HSR-RR-61/1-Se, AD 255 770).

On the basis of these realizations, a special effort was initiated to determine more precisely the state of knowledge with respect to possible social and psychological effects of air attacks and to generalize this knowledge to the conditions expected to exist in post-nuclear attack situations. The result of this particular effort culminated in the third Technical Note.[3]

Although the enormity of the practical task of the development of a total society model became evident, the task still appeared feasible in principle. Furthermore, it was obvious that any "total society" model would necessarily be composed of interlinked subsystem or component models. It seemed reasonable, therefore, to limit the scope of our endeavor somewhat and attempt to develop a subsystem or component model as a prototype to further model development of this kind. Accordingly, we redirected the final effort on this project toward the development of a prototype model of one element in the "total society" model. The aim here was to see whether or not we could translate some propositions about individual and group behavior in disaster into these consequences for system functioning.

In this effort, one phenomenon, known to be of some importance from disaster studies, the job/family conflict, was examined and a means for systematically projecting its impact on variables descriptive of post-attack situations--in this case, the availability of labor--was developed. This was not a study of the likely occurrences of role conflict and the ways in which such conflicts may be resolved; rather, it took assumptions, hypotheses, and findings about role conflicts as inputs to a mathematical model. The study itself was primarily concerned with the development of the model and exercising it to reveal the consequences of role conflict resolution on certain societal variables on an area or nationwide basis. It was primarily a methodological task and not a substantive research task.

The work initiated in this project has been continued and expanded in another project under sponsorship of the Office of Civil Defense. The following

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[3] P.G. Nordlie & R.D. Popper. Social Phenomena in a Post-Nuclear Attack Situation (Arlington, Va.: Human Sciences Research, Inc., August, 1961, HSR-RR-61/2-Se, AD 263 211).

major reports of the OCD work are highly pertinent to the present study and indicate the directions in which the early work on the present project has led.

An Approach to the Study of Social and Psychological Effects of Nuclear Attack, Human Sciences Research, Inc. (McLean, Va.: Author, March, 1963, HSR-RR-63/3-Rr, 423 pp. plus Appendices).

Vulnerabilities of Social Structure: Studies of the Social Dimensions of Nuclear Attack, S.D. Vestermark, Jr. (ed.) (McLean, Va.: Human Sciences Research, Inc., December, 1966, HSR-RR-66/21-Cr, 726 pp.).

Theories of Social Change and the Analysis of Nuclear Attack and Recovery, Neil J. Smelser (McLean, Va.: Human Sciences Research, Inc., January, 1967, HSR-RR-67/1-MeX, 151 pp. plus Foreword).

Civil Defense in Post-Attack Society: A Summary Report from a Research Program, Peter G. Nordlie and S.D. Vestermark, Jr. (McLean, Va.: Human Sciences Research, Inc., January, 1967, HSR-RR-67/2-MeX, 56 pp.).

Indicators of Social Vulnerability: Social Indicators in Civil Defense Planning and Evaluation, S.D. Vestermark, Jr. (ed.) (McLean, Va.: Human Sciences Research, Inc., August, 1968, HSR-RR-68/12-Be, 285 pp., plus Foreword).

While the present report is the last in the series, work is currently in progress, under Office of Civil Defense contract, to develop a more comprehensive model of post-attack system functioning which permits incorporating social and psychological factors in post-attack systems analysis and systems evaluation studies.

ABSTRACT

Purpose

At the time this report was prepared, post-attack planning was being conducted largely without consideration of behavioral factors. Partially, at least, this was because social science had not demonstrated the practical importance of such factors nor provided a means by which planners could take them into consideration. The purpose of this study, then, was (1) to demonstrate the practical importance of considering behavioral factors and (2) to develop a means for considering them in post-attack planning.

Method

The project designed to accomplish this involved taking one behavioral factor--the conflict which could arise between an individual's need to provide care to an injured family member and society's need for him to return to work and participate in societal recovery following a disaster--and estimating its impact on one area of post-attack planning: predictions of the number of people available for work following a disaster. Using Census and other related data, we developed mathematical procedures for determining the number of situations in which such a conflict would arise, made the assumption that a worker would return to work if, and only if, another adult were available to care for the injured, and computed the impact on available labor of the number who did not return to work as a result of this situation. The formulas developed were applied across five different types of population areas--urban, rural nonfarm, rural farm, etc.--for 190 types of population damage, and through several time phases; in all, 950 separate computer analyses were made.

Results

The results of the study are that, first of all, it was possible to incorporate this behavioral factor into post-attack planning, and secondly, there was demonstrable impact as a result: the available labor figure projected without considering this behavioral factor was in general at least 15 percent greater than that derived with such consideration throughout the first 85 days following attack, and in some instances was overestimated by a factor of four.

We believe that the results indicate that the method developed has provided a means of putting behavioral factors into a form which allows them to become a part of damage assessment procedures, to trace out systematically their effects, under a variety of assumptions about the attack itself and the pre-attack situation. The method has value as a prototype for tools which can examine these effects to better determine their relative importance to post-attack planning.

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CHAPTER I
INTRODUCTION AND BACKGROUND

The Rationale for Disaster Research

The existence of nuclear weapons has raised the fearsome possibility of a disaster of unknown proportions about which we as a society are just beginning to think. As might be expected, primary attention has been given to the physical effects of nuclear weapons: How many deaths or injuries might be sustained? How many buildings and facilities might be destroyed? But the world we know is more than physical structures. What do such figures mean in terms of their impact on society? This is the question we must ask ourselves now. How will varying patterns of destruction affect our social institutions? How will they affect the elements which compose those institutions? And ultimately, how much stress can those institutions withstand before collapse? The answers to these questions obviously cannot even be approached unless we develop an extensive understanding of human behavior, both individual and collective, under disaster conditions. If this is not done then there is the distinct danger that our preliminary studies in the physical effects of disaster will have been most misleading.

Characteristics of Disaster Research

Over the past few years a number of social scientists have been studying disaster in human society. Each has brought a somewhat different concept of society to the study of disaster, and the kinds of effects noted have been quite varied. Collectively, the studies have served to provide a fund of information about human behavior and the human condition in disaster situations. But to date, they have had little practical significance in terms of post-attack planning. At least part of the problem seems to be the lack of a methodology for making general use of the early discoveries which have been made; nor is there a framework within which the results of individual studies may be evaluated and understood.

Disaster studies generally proceed from the assumption that widespread death, injury, and destruction place great stress on the social mechanisms through which human activities are conducted. And it is hypothetized that the social and psychological effects of the disaster have implications for the functioning of those processes which are so fundamental to our social system. Thus, much of the disaster research has been concerned with identifying relevant social factors and processes. But this is only part of the task. To find, as some have, that role conflict, voluntary association, age, relative deprivation, the character of a community power structure, education, and experience are significant determinants of disaster behavior is not to determine how significant they are, or in what ways they are significant. To find that one of these factors or processes is significant under one set of disaster conditions (e.g., amount of destruction caused and type of society affected) is not to say that the same factors or processes will be equally important in another set of conditions. There is a need for research tools which can exploit the limited understanding of disaster behavior that we already possess.

Project Rationale

It has been with the hope of finding new and appropriate techniques for studying the effects of large-scale disruptions to societal activities that the present research was undertaken. One of the objectives of this research has been to explore the use of simulation as such a tool, applying it to the interaction between certain physical effects of a disaster agent and the behavioral disposition of actors in a damaged societal unit, particularly in terms of post-disaster labor force. The assumption from which we proceed is very much akin to that employed in the traditional survey studies: that specific classes of destruction are of importance for both primary and secondary reasons. We depart somewhat from the traditional approach in that we have not been concerned here with the detailed characteristics of the disaster agent, but only with certain classes of destruction which it has generated. Death, injury and destruction are considered to be the important independent variables, and not a particular hurricane with the force of

80-mile per hour winds, air attacks in the order of 2,000 megatons, or earthquakes with specific seismological characteristics. We have also narrowed the problem somewhat by concerning ourselves only with the operation of one behavioral factor, the resolution of job/family conflicts, as it affects one dependent variable, the size of a post-disaster labor force.

These restrictions were self-imposed; not because the area for study is narrow but rather because available resources for doing research are always limited, even when the problems of interest are endless. Additionally, we wanted to concentrate on exploring some of the methodological problems involved in using simulation in this way. Even though this one application has been restricted in terms of the problem area it treats, it is felt that the method developed will have wide application in the future and may serve as a basis for investigating the interactive effects of many classes of variables which are considered critical to disaster experience.

Problem Area and Objectives

Competition between job and family roles has long been recognized in disaster situations. Reports are often provided in anecdotal form by disaster survivors (for example, see Nagai, 1958; Hersey, 1958), and have also been collected with structured protocols developed by social scientists (see Form & Nosow, 1958). As early as 1952, Killian drafted a theoretical framework which was intended to explain the social and psychological dynamics underlying this phenomenon. Beyond this, little has been done except to challenge or support Killian's first work, or theories which have grown out of it.

The problem area with which we are dealing here can be offered as a hypothetical case in point. The National Resources Evaluation Center (NREC) has for some time been generating information regarding the vulnerability of the U.S. to nuclear attack. The output of their studies provides detailed estimates of the casualties that might be sustained by various "structures" in the society: population, industrial capacity, utilities, labor force, etc. The estimated size

of the post-disaster labor force is based on the expected number of pre-disaster members of the labor force who survive the disaster without serious injury. But what about role conflict; how about other behavioral factors? Such factors are not presently considered in NREC work, because social science has as yet been unable to provide them with estimates of how serious the behavioral factors will be.

As indicated, the problem with which this paper is concerned involves the effect of job/family role conflicts on the size of a post-disaster labor force. Specifically, our purpose is to draft a research tool through which the relationships between several variables may be explored. From a technical standpoint our approach to the problem is developed in several steps. In the present chapter we set out to explore the nature of the problems involved and the implications for developing the research tool. In subsequent chapters, a tool is developed and exercised.

Elements of the Conceptual Framework

The general components of the experiment described in this report are as follows:

1. The development of data on types and number of family structures--by role as workers, nonworkers, or dependents--in a given area;
2. The development of procedures for determining probable number and types of the family structures identified in (1);
3. The determination of the number and distribution of damaged-family situations which would present a role conflict;
4. The determination, based on interactions of the above factors, of the number of people available to work following the disaster;
5. The application of the methods developed to a variety of geo-population areas, through the range of possible damage patterns, and through a selected number of time periods.

The conflict situation, drawn from the literature on disaster situations, is that wherein a worker is faced with conflicting needs: to provide care to an injured member of his family, and to return to work, participating in societal

recovery. We are not concerned in this study with the immediate behavioral reactions of disaster survivors; much work has been done in that area. We assume that the immediate needs for food, etc., have been satisfied and we concern outselves solely with the need to provide care to the injured. The method we develop may well be used to analyze the impact of such other variables, but it has not been used to that purpose in this paper.

In the following sections we will discuss these elements as they relate to the development of a mathematical model designed to explore the relationships implied in the conceptual framework above.

Role

Although there is no centralized body of theory which embraces the social-psychological concept of "role," its use (either directly or indirectly) in organizing analytic frameworks has been most extensive in recent years. Some of this attraction to "role models" stems from their usefulness in linking an individual's behavior with the social system within which he behaves. "Roles," because they are embedded in value frameworks, serve as a guide to patterning individual behavior. Consequently, knowledge of the role within which an actor participates provides some insight into attitudes, expectations, and ultimately behaviors that can be reasonably expected from him. Most individuals act in several roles within a single life, and occasionally these roles may conflict: the various required role behaviors may compete for the limited resources available to any actor. The nature of role participation under ordinary conditions provides great opportunity for accommodation. Under disaster conditions, however, many of the mechanisms ordinarily available for making accommodations between potentially conflicting roles are under stress, and in such situations role conflict is a potential problem of considerable significance.

Our task in this paper concerns a practical aspect of this potential conflict. Competition between the occupational role, or job, and the family role of parent, husband, etc., has been selected for study, specifically as affecting the labor available after a disaster.

The Labor Force

Before attempting to estimate the effect of role conflict on the size of a post-disaster labor force it is necessary to make clear what is meant by the term "labor force." What is the labor force? Through what units can its size be described? How does it achieve its characteristic size? And what implications do the answers to these questions have for operationalizing a definition of labor force in this model?

The definition of labor force has been subject to considerable variation. For instance, in a study of Resources in America's Future, Landsberg, et al., (1963) define the labor force as "the number of persons of working age and their propensity to engage in gainful employment". From a different perspective, labor or employment statistics are generally collected to reflect only the number of people who are employed (the labor force) as opposed to those who are unemployed regardless of whether unemployment is due to choice or circumstance.

In their analysis of post-nuclear attack social phenomena, Nordlie and Popper (1961) also were confronted with the complexities of defining the labor force and further with the factors which influence its size after disaster. Using a modified supply-demand formulation of the post-attack manpower problem, they hypothesize several factors which can be expected to be of importance. In recognition of the problems of developing a truly adequate functionally-oriented definition of the labor force, they conclude that (in the post-disaster period) "Ultimately the labor supply consists of the entire surviving population".

This broader definition of manpower also is implied in a study of post-nuclear attack demography made by Heer (1964), in which the author categorizes manpower needs in terms of six functional categories. Heer's study differs from those above in that the functional categories which he uses to some extent are oriented to skill classifications and additionally make use of the idea of professionalism versus non-professional skills in the categories discussed.

A final area which should be mentioned involves work on the expected survivability of the labor force in a nuclear attack. Here the NREC uses several different levels of description to classify the labor force. For more gross studies, the number of persons actively employed is used. More refined inquiries use occupational classifications.

Since the present study is primarily concerned with the "labor force" from the standpoint of understanding the effect of a dynamic interaction upon it (casualty, production and role behavior) the definition itself is less important than consistent use of the one adopted. It is considered that consistency must be maintained within the boundaries of the model under development (in particular, the data inputs) and with regard to any applications of the results which derive. In the model reported in this paper, the "labor force" is used in its broadest sense to include all those over 14 years of age listed as "employed" in pre-attack census data.

Demographic Structure

Because we are concerned primarily with the distribution of occupational and familial roles in the population, it is necessary to adopt a descriptive format which embraces two "sets" of roles as they are practiced under ordinary circumstances. From the standpoint of occupational role participation, we only need to know whether a person is or is not, pre-disaster, a member of the labor force. Further refinements on the model could, of course, include such things as type of occupation and extent (full or part time) of employment.

The second consideration is occupational status as it co-exists with family status. Familial descriptions based in part on age, sex, and size of family are sufficient to delineate the notion of dependency in the family structure and to indicate the possibility of non-dependent family members available to return to the labor force.

The model constructed, then, incorporates those rules wherein participation in the post-disaster labor force can be related to the availability or unavailability of family members who are not dependent and who are also employed.

Within this framework, it is assumed that a working father would return to the labor force even if he had an injured child at home, if someone else--an uninjured wife or elder child--were available and able to provide the necessary care. The model developed characterizes the demography in a way that permits identifying the number of situations where the choice between providing care for an injured child and returning to the labor force could present a conflict.

Physical Effects of Disaster

Existing techniques for estimating physical damage were used as a point of departure for exploring the interaction between physical damage and the less tangible social factors. The model developed is intended as a supplement to other models which currently exist and is concerned with a behavioral implication which derives from the effects of physical damage.

Although it would be useful for some purposes (e.g., analysis of medical requirements) to determine the nature, severity and frequency of certain kinds of injuries, our concern here is primarily with the distribution of survivors and whether or not they are injured, thus being unavailable themselves and making someone else unavailable by requiring care.

Another concern is the manner in which the casualty or survival rates are to be distributed among the population of interest (in this case, family structures). "Ideally," disaster casualties would distribute themselves on a random basis across all population categories. This implies the assumption that all population categories would be equally vulnerable, both by virtue of their physical proximity to the disaster agent and also by virtue of their constitutional vulnerability to the stresses imposed by the disaster agent. If this were true, the aged, the infirm, men, women, children, office workers, or construction workers all would be equally susceptible to the physical effects of disaster damage. A strong argument, however, can be made against this assumption, for at various times of the day, the population with regard to any demographic breakdown, especially that of familial grouping, is not distributed randomly within the confines of geographic boundary. Where these groupings occur naturally, as a

result of persons collecting to practice their particular occupations, there is reason to believe that the percentages of casualties will not be randomly distributed. Additionally, there is a dearth of information regarding the physical susceptibility of the various role positions in the family structure to differential casualty rates. Such limitations can be accommodated by assumption in an analytical model. However, there is a clear need for empirical research to support more refined model construction.

The Rule for Behavior

As suggested, the function of this element in the model is to provide a basis through which the behavior of a population may be projected with respect to its response to a physical situation shaped by disaster damage. In the case at hand we have assumed that damage to the organization of a basic family unit provides the context within which decisions are made about returning to the labor force. The questions which still need to be explored regard the kinds of family damage which lead to conflict for the worker. This rationale has been suggested by the main themes from statements reporting role-conflict in a disaster situation, and by the available sociological theory explaining these phenomena (see Killian, 1952), "If the sirens went off, I would probably try to reach my family instead of a shelter" typifies the kind of conflict which arises post-disaster. But a question remains regarding how a population will respond to discrete categories of family damage. Unfortunately, little if any applicable research has been performed which could provide concrete data on the distribution of individual thresholds likely to produce a post-disaster defection from the labor force. All we can do at this point is make assumptions which appear to be reasonable and then use these as guides for future research. Probablistic methods in mathematics provide us with a tool flexible enough to accommodate almost any behavior rule that can be described.

Developing and Applying The Model

In Chapter II we will outline in detail the manner in which the model requirements discussed above are given mathematical expression. It was found that insufficient information exists today on which to proceed with the development of certain aspects of this model; where assumptions were necessary in the absence of firm data, these have been noted. In some cases we have speculated on what implications this may have for the model's output.

Chapter III reports on several applications of the mathematical model which were made using computers. Here we attempt to show the ways in which role conflict interacts with certain conditions of destruction to affect the size of the labor force. This has been done for a wide variety of destruction conditions and also a variety of demographic bases: metropolitan areas, urban areas, rural-farm areas, etc. A comparison also has been made between this data and time-scaled estimates for labor force participation in the Boston area following a large-scale nuclear attack which is expected to have generated certain characteristics of population damage.

CHAPTER II

CONSTRUCTION OF A MATHEMATICAL MODEL

The previous chapter discussed background considerations and specifications for construction of a mathematical model designed to explore the impact of role conflict on the size of a post-disaster labor force. The present chapter describes the translation of those requirements and specifications into a model.

Family Structure

The importance of the part played by family structure in determining which of those workers who are capable of returning to work will choose to return and which will choose not to return after a disaster has been discussed earlier. Family structure has been described, for our purposes, in terms of a three-part role system including:

1. the adult worker (W);
2. the adult non-worker (N);
3. the dependent (D), defined as a dependent child or an adult who is aged or infirm.

The notations above will be used to describe family structure in terms of those roles. The total number of <u>members</u> in a given family will be called M, and M will equal W + N + D. As an example of the use of this system of notation, consider the case of a family with seven members, two of whom are working adults, one a non-working adult, and the remaining four, dependents. The structure of this family would be described as (2, 1, 4).

The mathematical model developed here will be confined to consideration of only those families with two to six members, and those with eight members (representing the national average for larger families). With this restriction on family size, the universe of possible family structures is 125.

Unfortunately, neither national nor local census data are collected to reflect the distribution of families across the 125 possible structures. This lack of data necessitated the development of a method through which available data could be translated into the structural format specified. This was done through a series of steps incorporated into a computer subroutine. The results of this subroutine represent an estimate of the frequency of occurrence of each of the 125 possible structures.

Details of the operations performed in the subroutine are described in detail in Appendix A. For the present it should suffice to state that the major output from that subroutine for use in the next necessary step is a pair of proportions, R_1 and R_2, where R_1 represents the proportion of non-working adults in families, and R_2 is its complement, viz.: the proportion of non-working non-adults in families.

With the foregoing information developed, and with the addition of two new data inputs which are readily available, the distribution of families among the 125 possible structures can be determined, using Equation 1.

Equation 1.

$$\left[S = T_{(W+1,\ M-2)} \times B_{(M-W+1,\ N+1)} \times (R_1)^N + (R_2)^N \right] \times F_T$$

The elements of the equation are defined as:

S = the number of families in an area having a specific structure.

T = a national estimate of the proportion of families of a given size having a given number of members in the labor force.*

B = a binomial coefficient indicating the number of ways a given number of roles may be distributed within a family of a specific size.

* The national estimate was derived from Census Publication Series P-60, No. 37, extrapolated to include families of up to 8 members and 8 wage-earners.

W = the number of adult workers in the family under consideration. $(0 \leq W \leq 8)$

N = the number of adult non-workers in the family under consideration. $(0 \leq N \leq 8)$

M = the number of persons in the family under consideration, where $M = (W+N+D)$ - D = number of dependents in the family structure. $(2 \leq M \leq 6$, and $M = 8)$

F_T = the total number of families in the area being studied.

R_1 and R_2 are defined as above.

Application of Equation 1 to all situations which fit our assumptions for a given geo-population area yields a table of 125 S values, one for each family size - structure combination.

Casualty Distribution

Given the distribution of family structures generated by the rationale described above, the next task was to formalize a technique for depicting the way in which gross categories of population damage could be imposed on the various familial structures.* With an estimate of the frequency with which various family structures are damaged, we can identify those in which the conflict situation potentially reducing available labor exists.

It is important to realize that we are given only the proportion of survivors who are injured (or the proportion who might be injured) in a disaster area. We must assume the manner those casualties are likely to be distributed, not only among the general population of interest, but also within the family categories which are being examined. We have already presented the assumption that those conditions of family casualties where someone is available to care for injured members, a worker is more likely to return to work.

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* Actually, in the present application our interest is not in making detailed estimates of the damage which is likely to be sustained by all family structures; but rather with these restricted cases where the families contain adult members who were members of the pre-disaster labor force, who, if other things were equal, could return to the post-disaster labor force.

In the model under construction, then, the following assumptions are made:

<u>Assumption 1</u>: The family size-structure distribution is the same for any sub-area as it is for the entire area under consideration.

<u>Assumption 2</u>: Casualties are randomly distributed among families.

<u>Assumption 3</u>: Casualties are randomly distributed within families.

Assumption 1 appears reasonable for any large area with scattered high and low-income and ethnic groups. It implies that the number of families of a particular structure in any area is a function only of the population of that area and that this is reasonably estimated by the subroutine described above.

The second assumption is somewhat more complex and hence difficult to assess. It implies that all families are equally susceptible to the same chance of injury. It seems apparent that in high casualty areas, the tendency would be for persons in the same building (or even apartment) to sustain injuries as a group, rather than randomly; hence, we have reason to question Assumption 2. But considering the nature of radiation and blast injuries (the severity of which is largely a function of location and shielding), the assumption is more realistic if the assumed detonation comes at a time when families are separated and scattered throughout a city. The difficulty in arriving at a fixed basis for distributing casulties is caused not by a lack of mathematical method, but rather by a basic ignorance on our part of the way in which disaster casualties are produced. Equally difficult to assess is Assumption 3 where there are no empirical data which indicate the differential susceptibility of children, aged, or any other group, to injury from the physical force of the disaster.

The Conflict Situation

The second class of assumption regards the basis on which a job/family conflict situation emerges and is resolved. We are proceeding here on an assumption which is reasonable, but an assumption nonetheless; there are currently no validating empirical data.

Assumption 4: It is assumed that if an adult family worker survives without injury he would return to work if, and only if:

a. no members of his family were injured; or

b. there are injured family members but at least one non-injured non-working adult is available to care for them.

This assumption obviously doesn't cover all of the factors influencing a person's decision to return to work in a disaster situation. For instance, some people are less likely to make family-directed resolutions of the conflict than others: professional soldiers, medical practitioners, firemen and police generally would feel an obligation to duty that goes beyond those who are not affiliated with disaster occupations. On the other hand, some people will find a conflict not only in leaving the injured at home alone (as we have assumed), but also in leaving uninjured dependents. In these two examples, the single assumption which we have adopted would balance out some of the errors involved; further investigation of other relevant factors would of course be desirable.

The next step in our estimation is to formalize these assumptions into a set of rules to govern the allocation of uninjured adult family workers to the post-disaster labor force. The allocation procedure is based on the following:

> If there are N uninjured members of the pre-attack labor force in a family, we assign all N to the labor force even if there are injuries in the family, as long as there is at least one uninjured adult non-worker to take care of them. If, on the other hand, there are injuries in the family but there are no other adults to take care of them, we assign only N-1, leaving one ex-worker behind to care for the injured.

Under this rule, we can separate those families from which potential workers will come into the seven disjoint classes which are described in Table II-1.

TABLE II-1

Seven Possible Disjoint Post-Disaster Damage Patterns of Family Structures in Which Adult Family Workers May Be Found

(r and y are positive integers and x is any non-negative integer)

Damage Pattern	Adult Family Workers (W)			Adult Family Non-Workers (N)			Dependents (D)			allocate
	ok	inj	dead	ok	inj	dead	ok	inj	dead	
(1)	r	o	x	x	o	x	x	o	x	r
(2)	r	o	x	o	o	x	x	y	x	r-1
(3)	r	o	x	y	o	x	x	y	x	r
(4)	r	o	x	o	y	x	x	x	x	r-1
(5)	r	o	x	y	y	x	x	x	x	r
(6)	r	y	x	o	x	x	x	x	x	r-1
(7)	r	y	x	y	x	x	x	x	x	r

Notice that in damage patterns 1, 3, 5, and 7, there are either no injured members in the surviving family structure or there is at least one non-working adult to care for the injured. By our decision rule assumption, all surviving uninjured family workers in the structures would be available to return to work. However, in patterns 2, 4, and 6, there is at least one injury in the family and there are no uninjured adult non-workers available; in these cases, it will be assumed that one of the surviving workers will not return to the labor force but will choose instead to stay at home and care for the injured.

For each of the 125 possible family structures, then, we use the overall casualty percentages to determine the probability that each of the above damage patterns might occur. Multiplying this probability with the number of families in the area having this structure will yield the number which we might expect to sustain this type of destruction; then, multiplying that number with the associated number to be allocated (r or r-1 in the last column above), and summing over all family structures and damage patterns, we can derive the number of people "available" to return to work. The derivation of one of the formulae which determine these probabilities follows.

In damage pattern 6, where we have F families having W adult members in the pre-disaster labor force, N adult non-workers, and D members who have dependent status:

Let p_1 = the probability of being uninjured,

p_2 = the probability of being killed, and

p_3 = the probability of being injured, either fatally or non-fatally.

Based on our assumptions, we can estimate the probability that damage pattern 6 above will occur in the population of family structures; that is, that r ex-workers are uninjured, at least one ex-worker is injured (and the rest are dead), and all of the non-working adults are either injured or dead. Regardless of whether dependents are also injured, one uninjured worker will probably be referred to provide care for the injured worker(s). We may separate these probabilities for the purpose of clarity.

The first consideration is that for this type of post-disaster family structure to occur, there must be more than one ($W > 1$) worker in the pre-disaster structure. Since we allocate r-1 people from this class, we do not consider this class of families, unless $W \geq 2$.

Assuming this, we compute first the probability that, of the ex-workers, r will be uninjured and at least one will be injured. The probability that r are uninjured is $p_1^{\ r}$. But since there are W people from whom to choose this r, we see that there are $\binom{W}{r} = \frac{W}{r!(W-r)}$ ways to have r people escape unscathed. Therefore, the probability of having r of the W people unhurt is $\binom{W}{r} p_1^{\ r}$. Further, the probability of having s of the W people injured and the other W-r-s people dead is $p_3^{\ s} p_2^{\ W-r-s}$ with $\binom{W-r}{s}$ different ways that this can happen. Allowing s to take on all possible values (it must be greater than 1 by hypothesis) gives us:

$$\sum_{s=1}^{W-r} \binom{W-r}{s} p_3^{\ s} p_2^{\ W-r-s}$$

Combining this with the first probability gives us the probability that the set of W ex-workers will survive in the r, y, x, pattern as:

$$\binom{W}{r} p_1^{\,r} \sum_{s=1}^{W-r} \binom{W-r}{s} p_3^{\,s} p_2^{\,W-r-s}$$

Similarly, the probability that none of the other adults will be uninjured (i.e., the probability that all of the other adults will be either injured or killed) is:

$$\sum_{t=0}^{N} \binom{N}{t} p_2^{\,t} p_3^{\,N-t}$$

and the probability that the other family members sustain any or no injuries is:

$$\sum_{u=0}^{D} \binom{D}{v} p_1^{\,v} \sum_{v=0}^{D=u} \binom{D-u}{v} p_2^{\,v} p_3^{\,n-u-v} = 1.$$

Now the probability of all of these factors occurring in one family is of course the product of the probabilities. If we multiply this term by the number to be allocated, r-1, sum over all r of interest and multiply by F (the number of families having this W, N, D structure), we have the number of people allocated to the labor force from this group:

$$F\left[\sum_{r=2}^{W} (r-1) \binom{W}{r} p_1^{\,r} \sum_{s=1}^{W-r} \binom{W-r}{s} p_3^{\,s} p_2^{\,W-r-s} \sum_{t=0}^{N} \binom{N}{t} p_2^{\,t} p_3^{\,N-t}\right]$$

Formulae for the seven damage patterns of interest are derived similarly and are presented in Appendix B, with the constraints which allow us to apply them only to families having structures which will yield positive results.

If we apply each of these seven formulae (or cases) to a family structure, then its output will be the number of workers from that structure who are expected to be available for work, since they are neither dead, injured, nor

constrained by their family role. Executing the routine for each of the 125 family structures in a community and summing across them provides an estimate of the total number of workers who might, all other things being equal, be available after the disaster in that community.

If we compare this number to estimates of available labor projected without considering role conflict, the difference would indicate the number of workers who might not return to work because of role overload problems. If we then translate the difference into percentage terms, we may derive a degradation factor which can be applied to available labor estimates derived without considering role problems.

CHAPTER III

APPLICATION OF THE MATHEMATICAL MODEL

In the preceding chapter, a mathematical model or system was presented which was based on relationships between key variables expected to be determinant of the impact of role conflict on the size of a post-disaster labor force. The model was applied to a variety of disaster conditions in several types of population areas; this chapter presents the results of this application and discusses the relationships among the variables.

Disaster Conditions

As indicated earlier, one of the principal variables in determining the impact of role conflict is the amount of population damage. Disasters can produce a range of human damage in two categories, deaths and injuries, and a population can be described in terms of the percentages of people who are dead, injured, or uninjured. A primary interest in this effort is this potential range of damage which may be sustained.* On one end of such a continuum, a population may sustain zero percent injuries, zero percent deaths, leaving one hundred percent of the population in the undamaged category, with zero impact on the size of the labor force as a result of role conflict. On the other extreme is a disaster in which one hundred percent of the population are killed, zero percent of the population are injured and zero percent of the population fall into the null damage category. Lying between these two extremes is the wide variety of damage patterns or profiles in which role conflict may arise.

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*The National Resources Evaluation Center has developed what is probably the most comprehensive damage-assessment routine, based on the force released by the disaster agent, the distribution of the population with respect to that force and the availability of certain protective or rehabilitative capabilities such as shelters and medical supplies.

TABLE III-1

Example of Range of Possible Damage Profiles in the Percentage of Population Who are Killed, Injured or Neither

Killed	Injured	Neither
0	0	100
0	5	95
5	0	95
0	10	90
5	5	90
10	0	90
.	.	.
.	.	.
.	.	.
100	0	0

If the percentages of these three categories are graduated in units of five percent, we find that there are 190 patterns of interest, excluding the two extremes (see Table III-1) and we may expect role conflict to show 190 different characteristic effects with regard to its impact on the size of the labor force. In the exercise which is presented in this chapter, the model which was constructed in the previous chapter was applied in each of the 190 patterns of damage, giving a good indication of the impact of role conflict through the entire range of possible damage outcomes.

Demography

In addition to population damage, we have already pointed out the significance of population characteristics represented as a distribution of family structures consisting of working adults (W), non-working adults (N), and dependents (D). Thus, we explored various types of population areas in terms of the distribution of different family structures within them and, consequently, the impact of role conflict on a labor force. Populations have traditionally been defined in terms of political jurisdictions, and this classification has become an important basis of discrimination for social scientists interested in characteristic

patterns of behavior, demography, distribution of skills, etc., in these areas. This basis for classifying local populations is also useful in performing post-disaster damage assessment or pre-disaster damage estimation; it provides the analyst with a concrete way of referring to disaster effects in geographical as well as social space. To the extent that family structures vary by region, the impact of role conflict may be affected. For instance, if the center of a metropolitan area has a larger proportion of two-person family structures than does a rural area with many seven-person families, we may expect that the impact of role conflict would be different.

In the exercise which follows we have investigated the effects of role conflict in five different geo-population areas: an independent city, a metropolitan area, an urban fringe area, a rural nonfarm area and a rural farm area.

Approaches to the Application of the Model

There are several critical variables affecting the impact of role conflict on the postattack labor force. The distribution of family structures and the ways in which this distribution may vary by geographic locale have already been discussed. Undoubtedly, refinements can be made both in classifying geo-population units and determining the distribution of family structures within them. Similarly, the extent of damage and the classes of damage through which a post-disaster population may be described have been discussed and a variable format adopted for the study. Rules for behavior through which an individual may resolve the conflict between the demands of familial and occupational roles also can vary. However, at present there is no firm basis for determining how these rules might vary from area to area, from population to population, under different patterns of damage, and with regard to different family types. Refinements on such input data in the future can undoubtedly improve the accuracy of the model

*The development and rationalization of these categories as a classification scheme is reported in Nancy Kingsbury, A Geo-Population Classification Scheme, unpublished paper, Human Sciences Research, Inc., 1963.

which we have developed here. In the absence of more concrete information regarding role conflict resolution, we have assumed that the rules presented in Chapter II are appropriate.

It should be pointed out that at least two different orientations can be employed to analyze the effects of role conflict. On one hand we may approach the question in the abstract, in which case we would not be concerned with a specific disaster situation in which role conflict develops, but instead would only be interested in the manner in which the critical variables interact with one another to determine the characteristic degradations in post-disaster labor force size. Through such an analysis we would be able to draw conclusions reflecting the functional relationships between the variables involved.

From a somewhat different perspective we may explore the effects of these variables interacting in a specific disaster situation throughout the various phases of the disaster experience, from the time of impact until some distant time during the recovery phase.

In the following sections both of these approaches were explored. A total of 950 separate analyses were made (190 casualty profiles for each of five geo-population areas) on a high-speed electronic computer. The three-way interaction between casualties, demography and the role-conflict assumption was explored for each case; and the impact of the role conflict on the size of a post-disaster labor force was derived for each of the disaster situations so defined.

Appendix C provides a complete listing of casualty profiles for the five demographic areas with the characteristic effects that role conflict is seen to have on each combination. The unit through which the effect is described is not estimates of the post-disaster labor force, but rather the discrepancies between two methods for deriving that estimate; one in which role conflict is not considered as a significant variable and the second in which role conflict has been considered.

The Interaction with Casualty Profiles

In the present section we will discuss the characteristic manner in which the casualty profile and the conflict situation were found to produce an interaction affecting the size of the post-disaster labor force. In actuality, a somewhat different effect is noted for each of the geo-population areas; but, since each was comparable in form, we have selected to discuss only the findings relevant to the metropolitan area.*

The first set of data which derive from exercising the model using metropolitan area data shows the general way in which the degradation factor** relates to various casualty profiles. Figure III-1 shows that the range of values which derives depends upon the casualty profile observed. The data suggest that under varying conditions, estimates of the labor force which are not based on the expected operation of role conflict need to be degraded by a factor as high as .73. This implies that estimates of the post-disaster labor force made without regard to role conflict may be overestimated by a factor of four. On the other hand, in some of the damage profiles, labor force estimates with and without the role conflict consideration appear to be identical. This reinforces earlier suppositions that the significance of role conflict will vary according to certain disaster conditions (casualty profiles).

What becomes of importance, then, is ascertaining which conditions produce "significant effect." This is most complex. It is obvious from data percented in Figure III-1 that the degradation factor appropriate to any casualty profile is dependent upon all three elements which comprise that profile (percentage) killed, percentage injured, and percentage which are neither). When one of these parameters is fixed (for this illustration we used percentage killed) and the

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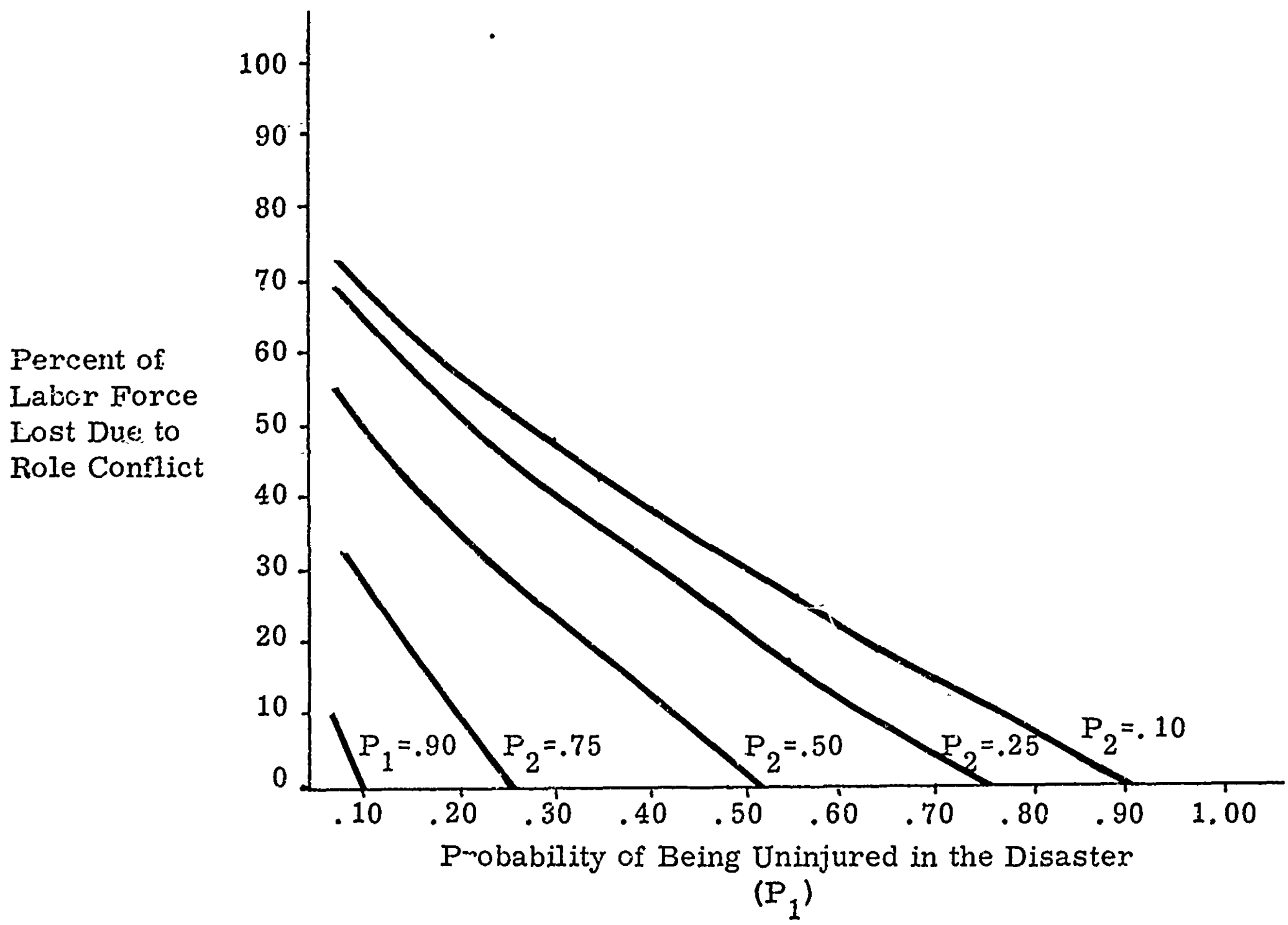
*Differences among the several areas were found to be a matter of degree. Discussion of all results has been confined to general tendencies observed; because of the exploratory nature of this study, it was not felt that precise parameter mapping was appropriate or necessary.

**"Degradation Factor" is defined here as the proportion by which the available labor force must be reduced to take into account the factor of role conflict.

FIGURE III-1

Labor Force Degradation Factor Due to Role Conflict As a Function of Varying Casualty Patterns for a Metropolitan Area



P_1 = probability of being uninjured

P_2 = probability of being killed

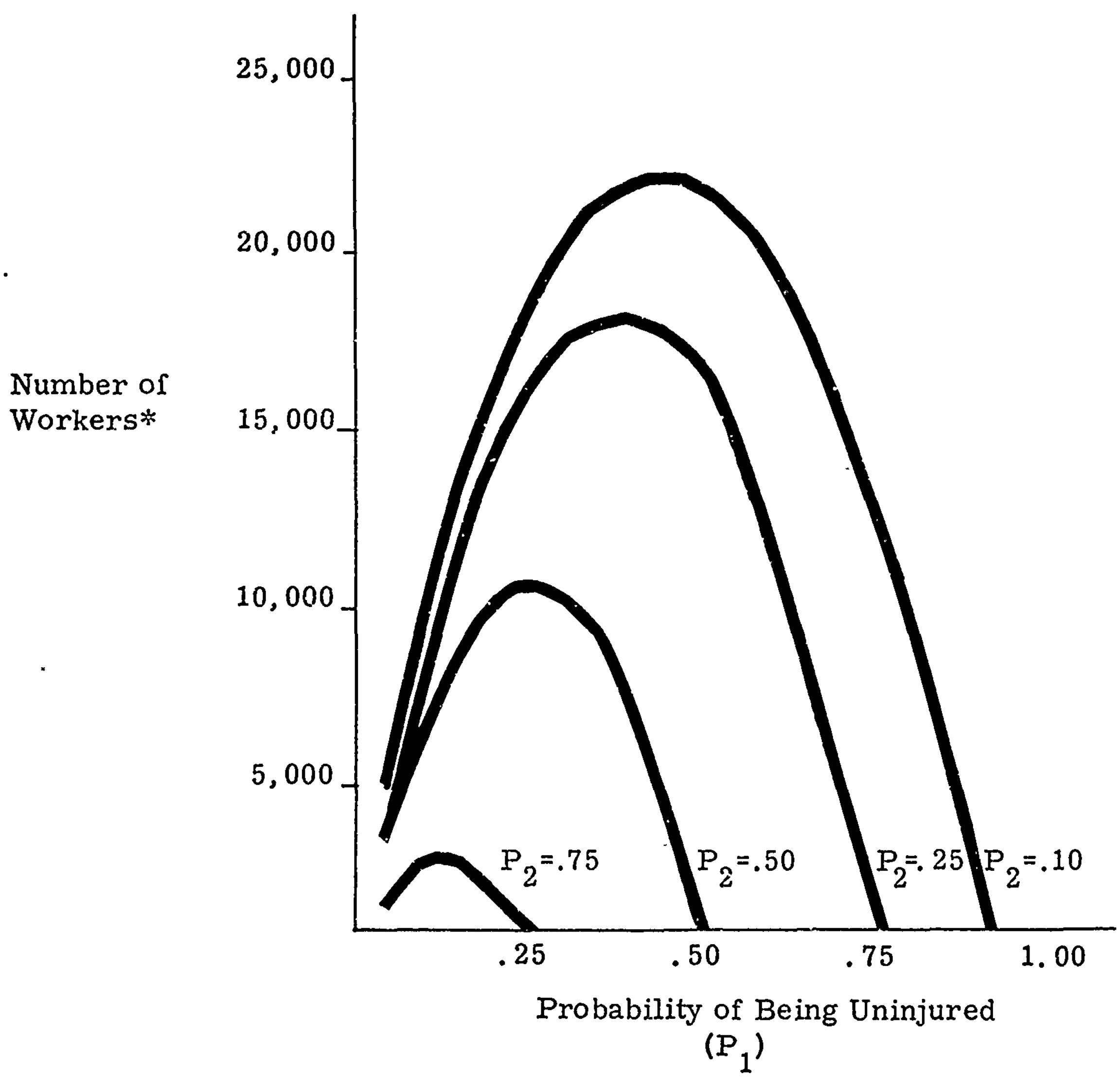
remaining two parameters varied to account for 100 percent of the post-disaster population, several characteristic patterns emerge in the data. This is again seen in Figure III-1, in which each curve is based on a fixed percentage of the population killed with the points on that curve reflecting the distribution of the remaining population between injured and those who survive intact. It becomes obvious here that as the ratio of injured to uninjured increases (hereafter referred to as the critical ratio), the net impact of role conflict is also increased. This is seen in each of the curves in Figure III-1: as the critical ratio becomes greater (signified by a decreasing value of p_1), the effect of role conflict on the labor force increases (indicated by higher degradation factor). An interesting feature of this relationship is the extent to which the percentage of the population who are killed actually places a constraint on the range of effects that role conflict might have. A general conclusion which can be drawn from the data is that as the proportion of deaths in a population increases and the number of "injured" diminishes there is less opportunity for roles to come into conflict.

When the probability of being killed is set, what patterns of change are manifest in the degradation factor as the injured to uninjured ratio increases in size? Figure III-2 provides some insights. Here we see that a curvilinear relationship exists between the critical ratio and the magnitude of the correlated degradation factors. This implies that the critical ratio producing the greatest effect is observed to occur when the ratio of injured to those uninjured reaches 1.00 (i.e. where $p_1 = p_3 = (1-p_2/2)$.) Hence, as the ratio of injured to uninjured moves away from unity in either the positive or the negative direction the magnitude of the degradation factor decreases; and consequently, as there is a greater concentration of injured or uninjured there is less opportunity for the role conflict phenomenon to affect the labor force.

Examination of the absolute numbers of workers who might be affected with each successive increment in the critical ratio reveals curves (Figure III-3) that are of a form inverse to those in Figure III-2. This suggests that although the degradation factor may be high, the actual numbers of people in the labor force expected to be affected might be quite low. This phenomenon is explained

FIGURE III-2

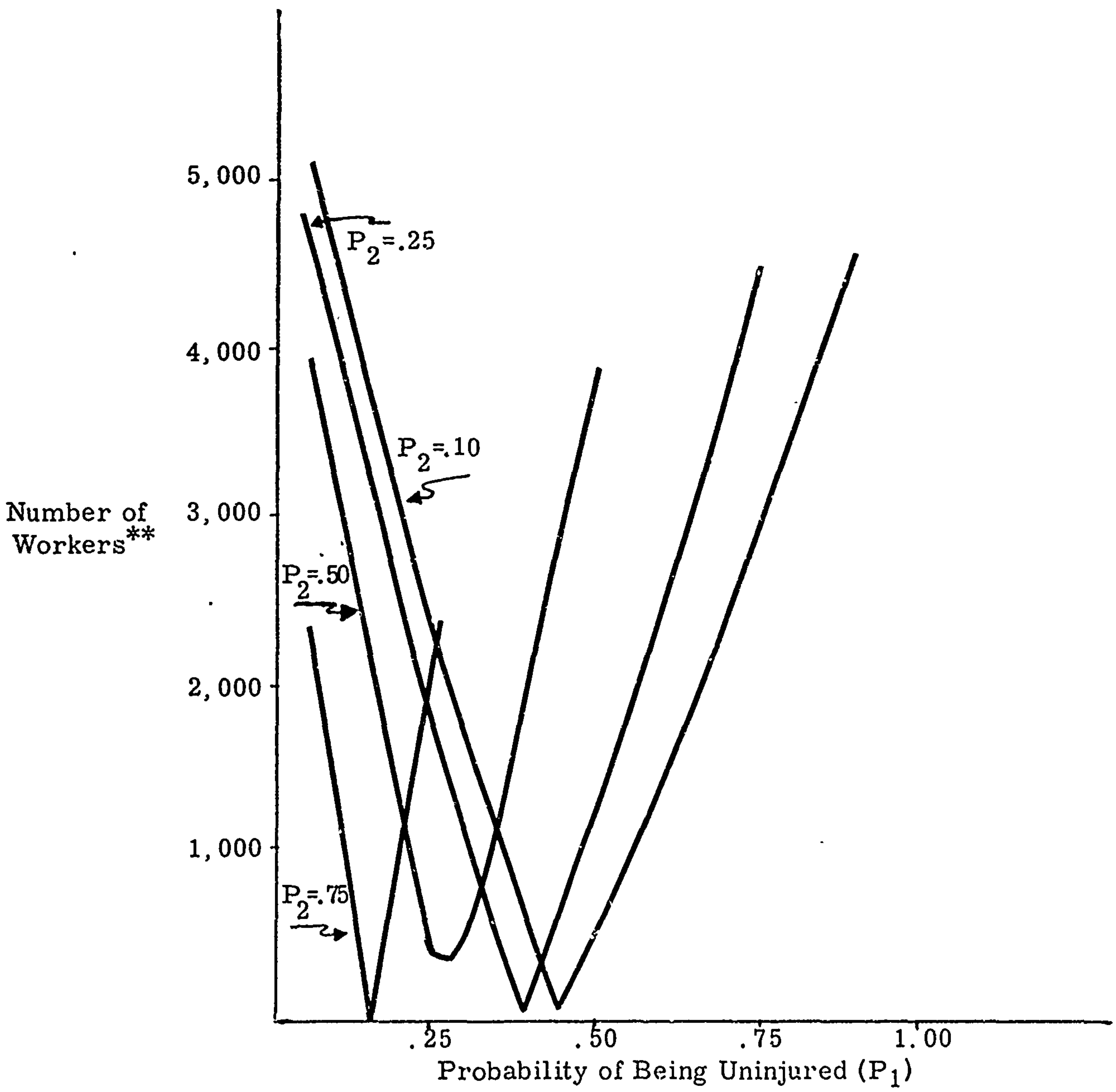
Effect of the Ratio of Injured to Uninjured on the Size of the Available Labor Force for Varying Casualty Patterns for a Metropolitan Area



*Difference between labor force available considering role conflict and labor force available, not considering role conflict.

FIGURE III-3

Discrepancy Between Successive Differences in Labor Force Estimates with Role Conflict Considered or Not Considered as Related to the Critical Ratio* for a Metropolitan Area



* $\frac{\text{No. Injured}}{\text{No. Uninjured}}$

**Discrepancy Between Differences in Size of Labor Force

by extremely low post-disaster labor estimates due to pervasive injury and further constrained by the role conflict phenomenon.

The Interaction with Demographic Areas

The operation of the demographic variable in this analytical system is equally interesting. Figure III-4 presents a set of curves which permit initial comparisons of role conflict's effects in different geo-population areas. As indicated in those curves, only "slight" differences appear between the several areas, and then only under a limited range of casualty conditions; further, these differences gradually diminish.

Using the degradation factor for comparison, however, may mask differences in the national post-disaster labor force. Greater numbers of the national or regional labor force are susceptible to damage in a metropolitan area than would be susceptible in any single rural farm area.*

In Figure III-5 we have plotted several characteristic curves showing estimates of the numbers of workers who might be affected in metropolitan areas as compared with rural-farm areas. In Figure III-6, data for these same two areas are pre. ented to show the numbers of workers who might be expected to return to work. Again, we have used estimates with the degradation factor built in. The results are considered highly significant, since they indicate that, although the effects of role conflict may be rather similar in relative terms (the degradation factor is standardized as a ratio), the impact of this variable in densely populated areas may have sharp effect in a disaster of national or even regional scope.

With such increase in scope, the distribution of casualties among the population areas becomes of critical importance. The summary conclusion which

*This also suggests that certain occupational classifications are likely to be more prone to the negative effects of role conflict interacting with disaster than others.

FIGURE III-4

Labor Force Degradation Factor Due to Role Conflict for Various Casualty Patterns Compared for Five Different Types of Geo-Population Areas

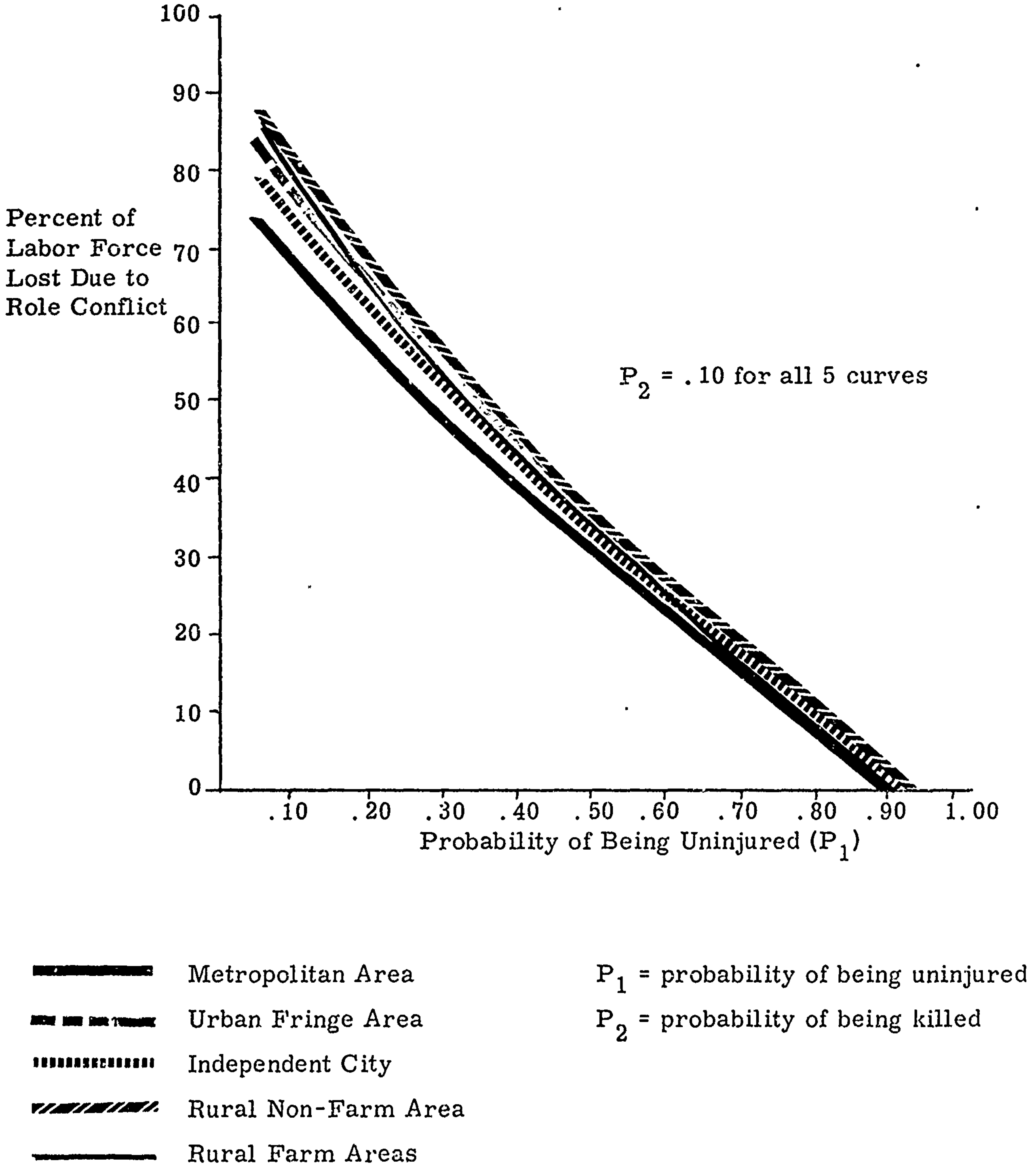


FIGURE III-5

Comparison of the Effect of Role Conflict on Size of the Labor Force for Given Casualty Patterns in Two Geo-Population Areas

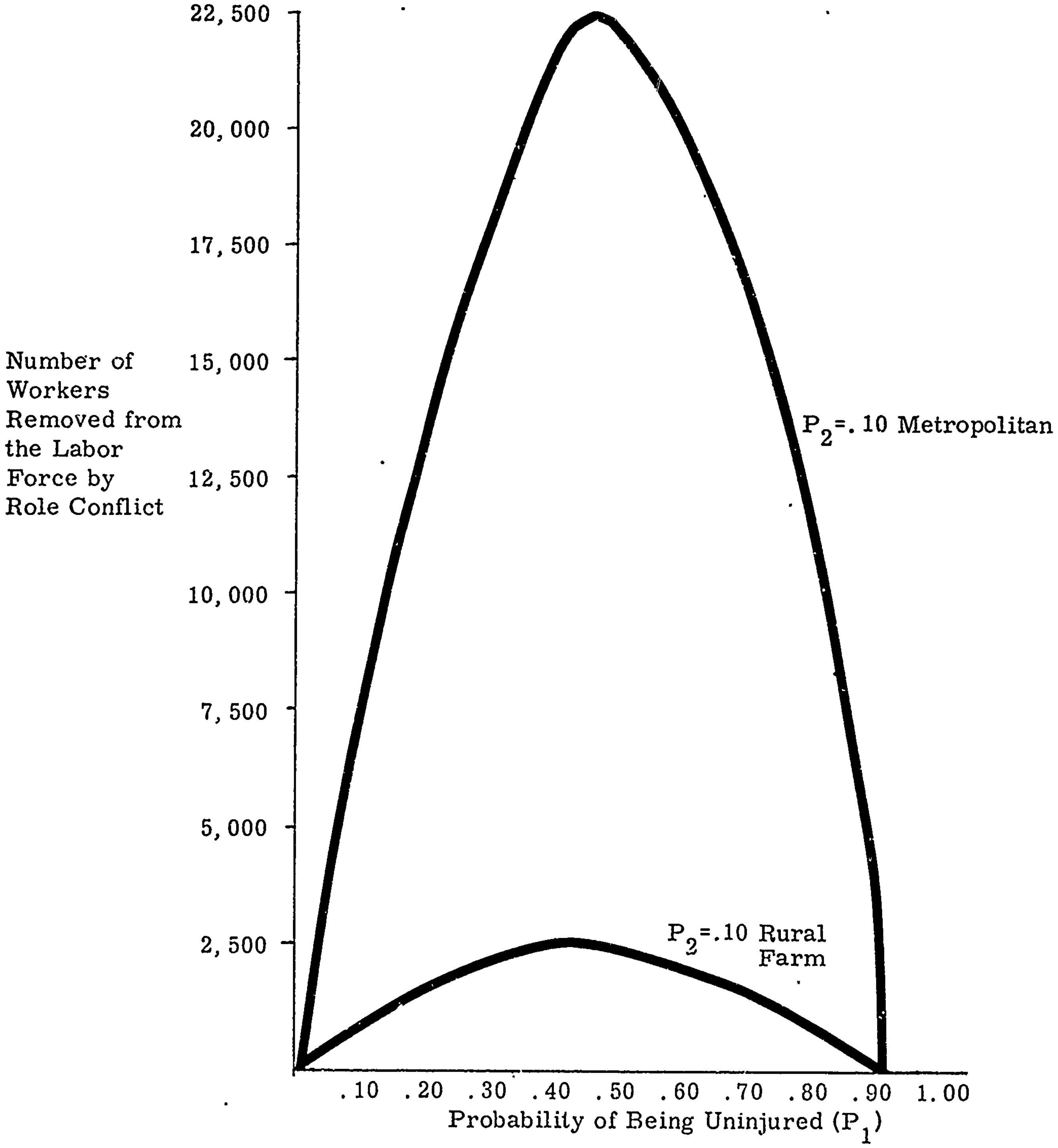
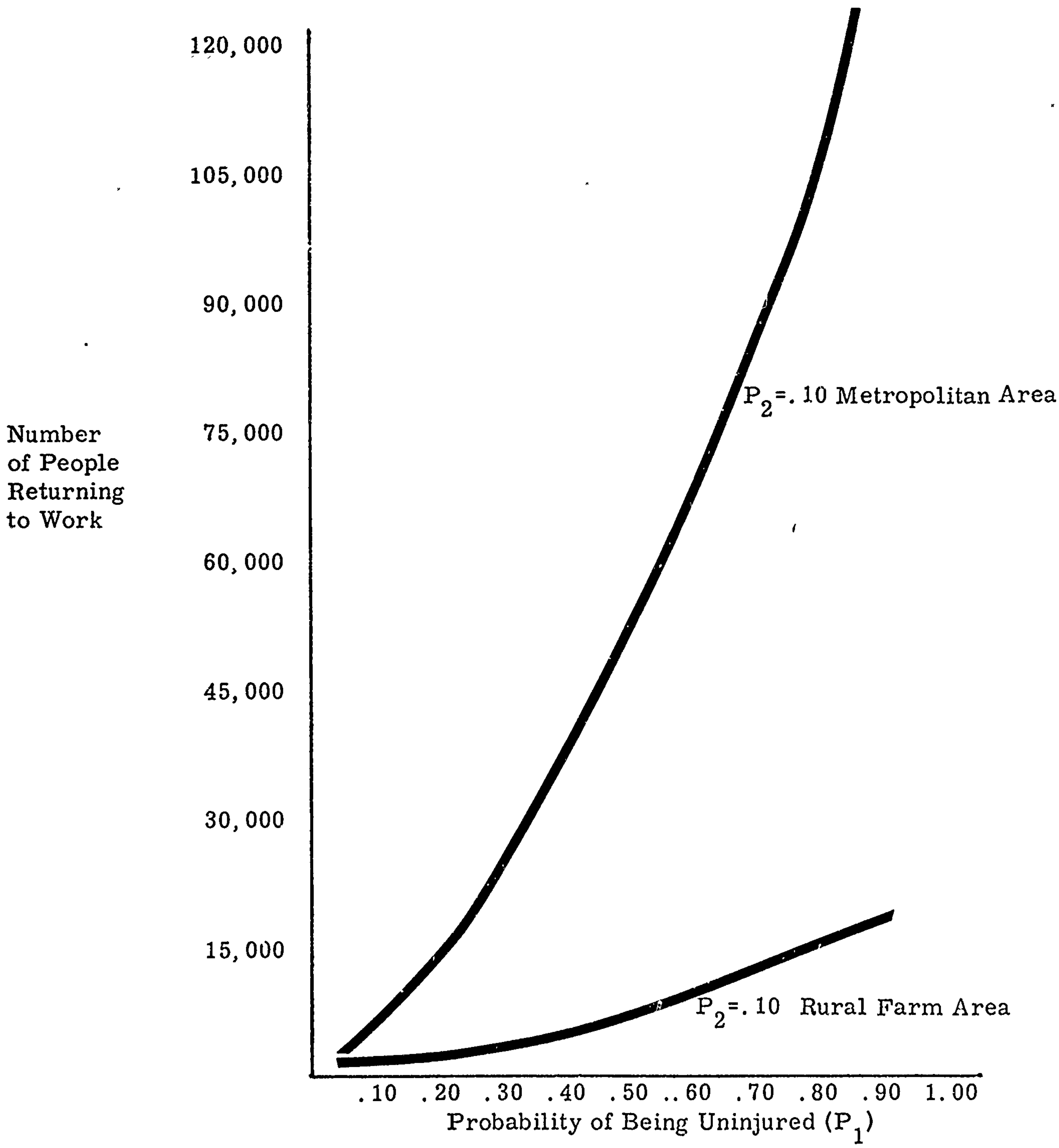


FIGURE III-6

Comparison of Two Geo-Population Areas in Terms of Number Returning to Work for Given Casualty Patterns



one must draw from the preceding two sections is that role conflict as a social phenomenon, while a main effect, is integrally related in complex interactions with the casualty profiles which might prevail after a disaster, as well as with a demographic composition of the area it has affected.

The Interaction with Time Phases

Because they were developed for the general case, the results of the preceding analysis are considered only a first step in estimating the expected impact of job/family role conflicts on the size of a post-disaster labor force for specific possible disaster situations. The present section applies these results to an estimated damage profile for one disaster situation in which the size of the post-disaster labor force was projected; and then, by comparing the two estimates of the post-disaster labor force (the first deriving from an analytic study in which role conflict was considered as a factor and the second in which this factor was not considered), explores the influence of this variable on the post-disaster labor force through time.

The comparison is made possible through the use of a set of data generated in a damage estimation study performed by the National Resources Evaluation Center. The specific disaster situation under study comes from a gamed nuclear attack on the city of Boston, Massachusetts. In that study it was hypothesized that a single, ten megaton weapon detonated in a surface burst in the eastern part of South Boston producing the time phased casualties shown in Table III-2.

These figures were used as a basis for estimating the number of survivors in general and the number of survivors from a pre-attack labor force in particular. An estimate of the appropriate degradation factor was determined for each of the damage profiles relating to the several time segments after the supposed attack and applied to the first estimate of post-attack labor force size. A comparison of the two sets of results was then made (see Table III-3).

TABLE III-2

Casualty Pattern in Five Time-Phases

Days after Detonation	Percent Uninjured P_1	Percent Dead P_2	Percent Injured P_3	Total
1	54.80	28.75	16.45	100.00
15	56.33	29.52	14.15	100.00
30	57.20	30.07	12.72	100.00
90	59.87	32.50	7.63	100.00
365	66.79	32.72	.50	100.00

TABLE III-3

Comparison of Labor Force Size With and With Consideration of Role Conflict

Days after attack	Population percent uninjured	Estimated size of labor force	Estimate of degradation factor	Degraded estimate of postattack labor force
1	.5480	591,002	15.39	500,047
15	.5633	607,503	13.68	524,597
30	.5720	616,936	11.12	570,553
90	.5987	645,714	6.37	604,582
365	.6678	720,273	1.00	713,070

The results of this comparison are revealing. For those who are prone to discount the impact of social and psychological variables, the 15 percent difference estimated here for the early phases of the post-disaster period should provide a basis for reconsidering the simplistic models of damage on which estimations generally have been based. Perhaps the impact of the role conflict factor shows up most significantly when we realize that (D + 1) estimates of labor force size under the role which assumes no conflict are not achieved until approximately 85 days after impact.* On the other hand, the results do not suggest that the impact of job/family role conflict is sufficient to completely devastate the post-disaster labor force. In fact, considering that the damage profiles for this exercise were rather extreme (as compared to natural disasters), it appears that job/family role conflicts may only be of significance to the post-disaster labor force for disasters of extraordinary proportions. In the main, however, the results of this exercise are useful in describing (but not evaluating) the approximate effect of job/family role conflict on the size of a post-disaster labor force through several phases of the post-disaster period.

The improved estimation capability is of interest and value on two grounds. First, it provides the planner with a somewhat more refined estimate of the size of a labor force on which he can base his plans for economic, logistic, and consequently, social recovery from disaster. On this basis, plans may be developed which involve a less severe time schedule for reconstruction through more selective use of available personnel; welfare and/or relief requirements may be more accurately projected as the number of able-bodied adults is more accurately assessed; and so on. This information might prompt planners to take steps to reduce role conflict in some situations; they might, for instance, plan for care centers of such quality as to convince the family worker that his responsibility to loved ones can "best" be satisfied through institutionally provided sources and that his most effective function would be to return to a labor force the national recovery effort.

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*It should not be inferred that this is a generalized finding, since it is dependent upon a specific damage profile.

These are merely alternatives about which we are speculating. But with more refined estimates of social damage, the various alternatives can be evaluated more rationally and perhaps more effectively. Additionally, and perhaps most significantly, this kind of study shows that it is possible to refine our understanding of the vulnerability of our society (as well as foreign societies) to the impact of disaster in somewhat more specific terms than we have heretofore used.

CHAPTER IV
SUMMARY AND IMPLICATIONS

This study was conceived in response to the general fact that although a considerable body of knowledge about the likely social and psychological effects of a nuclear attack was accumulating, this knowledge was not being utilized in the analysis of post-attack situations or in recovery planning or evaluation. One of the major reasons for this non-utilization appeared to be related to the fact that, in general, the behavioral science information was not in a form in which it could be taken systematically into account in damage assessment and systems evaluation procedures. Methods were needed, therefore, which would permit transforming behavioral factors into forms in which they could be taken into account.

This study was an attempt to develop and illustrate a method which might be used to incorporate behavioral factors into the analysis and depiction of post-attack situations. One factor, the role-conflict phenomenon, was selected from the findings of post-attack behavior studies as the particular factor to be used in developing and illustrating the application of the method. Conclusions from earlier studies of post-attack behavioral phenomena suggested the likely high incidence of conflict between survivors' work and family roles. The problem, then, was how this general finding might be translated into quantitative effects.

The scope of the problem was made manageable by a number of limiting assumptions and a method was devised for relating role-conflict to its effect on estimates of the post-attack work force. Formulas were developed for estimating the effect on available labor, and the formulas were applied in five different types of population areas for 190 types of population damage through several time phases. Results were presented in terms of comparisons between labor force estimates made with and without the role-conflict factor. These results tended to show that during the first 85 days, the role conflict factor had a significant effect on estimations of labor available. While the average differences were on the order of fifteen percent, there was high variability across situations and in some cases

the labor available estimated with the role conflict factor included was less by a factor of four than that estimated without it.

We believe that the results indicate that the method developed has value as a prototype for developing methods to incorporate behavioral factors into post-attack damage assessment and systems evaluation. There is no claim, of course, that the method in any way validates or supports the original propositions about the likely incidence and effects of the role conflict phenomenon. What it does do is provide the means for putting behavioral factors into a form which allows them to become a part of damage assessment procedures and to trace out systematically their effects under a variety of assumptions about the attack itself and the pre-attack situation. The method, therefore, should be understood to be a tool for examining possible effects to better determine their relative importance to post-attack planning.

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APPENDICES

APPENDIX A:

THE FAMILY STRUCTURE SUBROUTINE

Elements of the Available Data Input Base

PFAM = Proportion of families with n members ($2 \leq n \leq 7$ or more)

HDS = Number of families in a given geo-population area (actually number of heads of primary families)

INH = Number of persons in households

O = Number of non adult family members in households (age 14 and under)

PR = Number of primary individuals in households

U = Number of unrelated individuals in households

G = Number of group-quartered individuals in households

(PR, U, G: non-family members)

PR_{14} = Number of primary individuals 14 years and under in households

U_{14} = Number of unrelated individuals 14 years and under in households

G_{14} = Number of group-quartered individuals 14 years and under in households

(PR_{14}, U_{14}, G_{14}: non-family members)

Q_m = Proportion of families with m workers ($1 \leq m \leq 3$)

W_{14} = Number of 14 year-olds in the labor force

LF = Number of individuals (14 years and older) in the labor force

B_{IJ} = Binomial coefficient for the combinations of I things taken J at a time ($O \leq I \leq 8$; $O \leq J \leq 10$)

Elements of the Derived Data Input Base

F = Number of family members in households $\quad F = INH - PR - U$

PRO = Proportion of primary individuals who are 14 years and under $\left(\frac{PR_{14}}{PR}\right)$

PUO = Proportion of unrelated individuals who are 14 years and under $\left(\frac{U_{14}}{U}\right)$

Elements of the Derived Data Input Base (cont)

PGO = Proportion of group-quartered individuals who are 14 years and under $\left(\frac{G_{14}}{G}\right)$

FW = Number of workers who are family members

$FW = (Q_1 + 2Q_2 + 3Q3) \times HDS$

FWO = Number in the labor force who are 14 years old (i.e. number of non-adult workers)

$FWO = (FW) \times (W_{14}/LF)$

Definitions of Family Structure Elements

K = Number of workers in a given family $(O \leq K \leq 8)$

M = Number of adult members of a given family who are not in the labor force $(O \leq M \leq 8)$

N = Number of other (dependent) members in a given family $(N = L - K - M)$

L = K + M + N = Total number of members in a given family $(2 \leq L \leq 8)$

Subroutine Output

PA = Proportion of adults in families

R_1 = Proportion of non-working adults in families

R_2 = Proportion of non-working, non-adult family members

S = Number of families of a given size and structure

Operations of Subroutine

1. Determine PA:

$$PA = \left[F - o + G\,(PGO) + U\,(PUO) + PR\,(PRO)\right] / F$$

2. Determine R_1:

$$R_1 = \left[PA(F) - FW + FWO\right] / (F - FW)$$

Operations of Subroutine (cont)

3. Determine R_2:

$$R_2 = 1.00 - R_1$$

4. Determine S:

$$S = \left[\left(T_{K+1, L-2} \right) \times \left(B_{L-K+1, M+1} \right) \times (R_1)^M \times (R_2)^N \right] \times HDS$$

where $0 \leq K \leq 8$

$0 \leq M \leq 8$

$N = (L - K - M)$

$2 \leq L \leq 8$

APPENDIX B:

TRANSPOSED FLOWCHART QUANTITIES

$$A1 = \sum_{r=1}^{k} r\binom{k}{r} P_1^{\,r} P_2^{\,k-r}$$

$$B1 = \sum_{v=1}^{m+1} \binom{m}{v-1} P_1^{\,v-1} P_2^{\,m-(v-1)} = \sum_{s=o}^{m} \binom{m}{s} P_1^{\,s} P_2^{\,m-s}$$

$$Q = \sum_{v=1}^{n+1} \binom{n}{v-1} P_1^{\,v-1} P_2^{\,m-(v-1)} = \sum_{t=o}^{m} \binom{m}{t} P_1^{\,t} P_2^{\,n-t}$$

$$C1 = \sum_{t=1}^{n} \sum_{v=1}^{n-t+1} \binom{n}{t} \binom{n-t}{v-1} P_3^{\,t} P_1^{\,v-1} P_2^{\,n-t-(v-1)}$$

$$= \sum_{t=1}^{n} \sum_{u=o}^{n-t} \binom{n}{t}\binom{n-t}{u} P_3^{\,t} P_1^{\,u} P_2^{\,n-t-u}$$

$$Q = \sum_{s=1}^{m-1} \sum_{t=1}^{m-s} \binom{m}{s} \binom{m-s}{t} P_1^{\,s} P_3^{\,t} P_2^{\,m-s-t}$$

$$A2 = \sum_{r=2}^{k} (r-1)\binom{k}{r} P_1^{\,r} P_2^{\,k-r}$$

$$B4 = \sum_{s=1}^{m} \binom{m}{s} P_3^{\,s} P_2^{\,m-s} .$$

Transposed Flowchart Quantities

$$Q1 = \sum_{t=1}^{m} \sum_{v=1}^{m-t+1} \binom{m}{t}\binom{m-t}{v-1} P_1^{\,t} P_2^{\,v-1} P_3^{\,m-t-(v-1)}$$

$$= \sum_{t=1}^{m} \sum_{u=o}^{m-t} \binom{m}{t}\binom{m-t}{u} P_1^{\,t} P_2^{\,u} P_3^{\,m-t-u}$$

$$Q2 = \sum_{r=1}^{k-1} \sum_{s=1}^{k-r} r\binom{k}{r}\binom{k-r}{s} P_1^{\,r} P_3^{\,s} P_2^{\,k-r-s}$$

$$Q = \sum_{r=2}^{k-1} \sum_{s=1}^{k-r} (r-1)\binom{k}{r}\binom{k-r}{s} P_1^{\,r} P_3^{\,s} P_2^{\,k-r-s}$$

Transposed Flowchart Quantities

DERIVATIONS

P_1 = probability of being uninjured

P_2 = probability of being killed

P_3 = probability of being injured

K = preattack workers

M = preattack, healthy, nonworking adults

N = preattack other people

I. Formula 1

Condition: No injuries in the family in any category.

A. Probability that r ex-workers are uninjured and k-r are dead.

$$P_1^{\,r} P_2^{\,k-r}$$

Since k people from whom to choose this r, the possible ways are:

$$\binom{k}{r} = \frac{k!}{r!\,(k-r)!}$$

so that probability of r of k ex-workers unhurt and remainder dead is:

$$\binom{k}{r} P_1^{\,r} P_2^{\,k-r}$$

Transposed Flowchart Quantities

I. Formula 1 (continued)

B. Probability of s of m other adults unhurt and remainder dead is:

$$\binom{m}{s} P_1{}^s P_2{}^{m-s}$$

Summing over all possible values of s (o to m) gives:

$$\sum_{s=o}^{m} \binom{m}{s} P_1{}^s P_2{}^{m-s}$$

C. Probability of t of n other people unhurt and remainder dead is:

$$\binom{n}{t} P_1{}^t P_2{}^{n-t}$$

Summing over all possible values of t (o to n) gives:

$$\sum_{t=o}^{m} \binom{n}{t} P_1{}^t P_2{}^{n-t}$$

D. Combining A, B, and C gives the probability that the above occurs in one family. Since all r surviving ex-workers are allocated to the work force, multiplying by r and summing over all r of interest ($r > o$) gives the probability of a family of (k, m, n) preattack structure surviving in a $[(r,o,x), (s, o, x), (t, o, x)]$ pattern to contribute r workers to the labor force. Multiplying this by the total number of families gives:

$$N\left(\sum_{r=1}^{k} r\binom{k}{r} P_1{}^r P_2{}^{k-r}\right)\left(\sum_{s=o}^{m} \binom{m}{s} P_1{}^s P_2{}^{m-s}\right)\left(\sum_{t=o}^{n} \binom{n}{t} P_1{}^t P_2{}^{n-t}\right)$$

which represents the number of workers to be allocated to the labor force for the group of families surviving in this particular pattern.

Transposed Flowchart Quantities

II. Formula 2

A. Probability of r of k ex-workers surviving in a (r, o, x) pattern is:

$$\binom{k}{r} P_1{}^r P_2{}^{k-r}$$

B. Probability of all m other adults being dead is: $P_2{}^m$

C. Probability of $s(1 \leq s \leq n)$ other people being injured, $t(o \leq t \leq n-s)$ people being healthy, and rest dead is:

$P_3{}^s P_1{}^t P_2{}^{n-t-s}$ Since there are $\binom{n}{s}$ ways of having s people injured and $\binom{n-s}{t}$ ways of having t of the others healthy, the probability of having n non-adults surviving in a (t, s, x) pattern is:

$$\binom{n}{s}\binom{n-s}{t} P_3{}^s P_1{}^t P_2{}^{n-t-s}$$

Summing over all possible values of s and t gives:

$$\sum_{s=1}^{n} \sum_{t=o}^{n-s} \binom{n}{s}\binom{n-s}{t} P_3{}^s P_1{}^t P_2{}^{n-s-t}$$

D. Since 1 ex-worker must tend the injured, only $r-1$ workers can be allocated. Combining all terms, multiplying by the $(r-1)$ workers allocatable, summing over all r of interest $(2 \leq r \leq k)$, and multiplying by the total number of families gives:

$$N\left(\sum_{r=2}^{k} (r-1)\binom{k}{r} P_1{}^r P_2{}^{k-r}\right)\left(P_2{}^m\right)\left(\sum_{s=1}^{n} \sum_{t=o}^{n-s} \binom{n}{s}\binom{n-s}{t} P_3{}^s P_1{}^t P_2{}^{n-s-t}\right)$$

which represents the contribution to labor force from this family structure.

Transposed Flowchart Quantities

III. Formula 3

A. k ex-workers survive in a (r, o, k-r) pattern has a probability of:

$$\binom{k}{r} P_1{}^{r} P_2{}^{k-r}$$

B. m other adults surviving in a (s, o, x) pattern has a probability of:

$$\binom{m}{s} P_1{}^{s} P_2{}^{m-s}$$

C. n other people surviving in a (u, t, n-t-u) pattern has a probability of:

$$\binom{n}{t}\binom{n-t}{u} P_3{}^{t} P_2{}^{n-t-u} P_1{}^{u}$$

D. Conditions:

(1) r people allocatable to labor force,

(2) $s > o$,

(3) $t > o$,

(4) $r > o$, lead to:

$$N\left(\sum_{r=1}^{k} r\binom{k}{r} P_1{}^{r} P_2{}^{k-r}\right)\left(\sum_{s=1}^{m}\binom{m}{s} P_1{}^{s} P_2{}^{m-s}\right)\left(\sum_{t=1}^{m}\sum_{u=o}^{n-t}\binom{n}{t}\binom{n-t}{u} P_3{}^{t} P_1{}^{u} P_2{}^{n-t-u}\right),$$

as contribution to labor force from this family structure.

Transposed Flowchart Quantities

IV. Formula 4

A. Probability of k ex-workers surviving in a (r, o, k-r) pattern is:

$$\binom{k}{r} P_1^{\,r} P_2^{\,k-r}$$

B. Probability of m adults surviving in a (o, s, m-s) pattern is:

$$\binom{m}{s} P_3^{\,s} P_2^{\,m-s}$$

C. Probability of n other people being healthy, injured, or dead is 1.

D. Conditions:

(1) r-1 workers available

(2) $s > o$

(3) $r > 1$ to be of interest, lead to:

$$N\left(\sum_{r=2}^{k} (r-1)\binom{k}{r} P_1^{\,r} P_2^{\,k-r}\right)\left(\sum_{s=1}^{m}\binom{m}{s} P_3^{\,s} P_2^{\,m-s}\right)$$

for contribution from this labor force.

V. Formula 5

A. Probability of k ex-workers surviving in a (r, o, k-r) pattern is:

$$\binom{k}{r} P_1^{\,r} P_2^{\,k-r}$$

B. Probability of m adults surviving in a (s, t, m-s-t) pattern is:

$$\binom{m}{s}\binom{m-s}{t} P_1^{\,s} P_3^{\,t} P_2^{\,m-s-t}$$

Transposed Flowchart Quantities

V. Formula 5 (continued)

C. Probability of n other people being healthy, injured, or dead is 1.

D. Conditions:

(1) r workers available

(2) $1 \leq s \leq m-1$ (at least one is injured so s never equal to m)

(3) $1 \leq t \leq m-s$

(4) $r > o$ to be of interest, leads to:

$$N\left(\sum_{r=1}^{k} r\binom{k}{r} P_1{}^{r} P_2{}^{k-r}\right)\left(\sum_{s=1}^{m-1} \sum_{t=1}^{m-s} \binom{m}{s}\binom{m-s}{t} P_1{}^{s} P_3{}^{t} P_2{}^{m-s-t}\right)$$

VI. Formula 6

A. k ex-workers survive in a (r, s, k-r-s) pattern has a probability of:

$$\binom{k}{r}\binom{k-r}{s} P_1{}^{r} P_3{}^{s} P_2{}^{k-r-s}$$

B. m other adults surviving in a (o, t, m-t) pattern has a probability of:

$$\binom{m}{t} P_3{}^{t} P_2{}^{m-t}$$

C. Probability of n other people being healthy, injured, or dead is 1 .

D. Conditions:

(1) r-1 workers available

(2) $2 \leq r \leq k-1$ (to be of interest and since at least 1 is injured)

Transposed Flowchart Quantities

VI. Formula 6 (continued)

D. (continued)

(3) $1 \leq s \leq k-r$ (since 1 ex-worker is injured)

(4) $o \leq t \leq m$, lead to:

$$N\left(\sum_{r=2}^{k}\ \sum_{s=1}^{k-r} (r-1)\binom{k}{r}\binom{k-r}{s} P_1^{\,r} P_3^{\,s} P_2^{\,k-r-s}\right)\left(\sum_{t=o}^{m}\binom{n}{t} P^{\,t} P_2^{\,m-t}\right)$$

VII. Formula 7

A. k ex-workers survive in a $(r, s, k-r-s)$ pattern has a probability of:

$$\binom{k}{r}\binom{k-r}{s} P_1^{\,r} P_3^{\,s} P_2^{\,k-r-s}$$

B. m other adults survive in a $(t, u, m-t-u)$ pattern has a probability of:

$$\binom{m}{t}\binom{m-t}{u} P_1^{\,t} P_3^{\,u} P_2^{\,m-t-u}$$

C. Probability of n other people being healthy, injured, or dead is 1.

D. Conditions:

(1) r workers available

(2) $1 \leq r \leq k-1$ (to be of interest and at least 1 be injured)

(3) $1 \leq s \leq k-r$ (at least 1 is injured)

(4) $1 \leq t \leq m$, lead to:

$$N\left(\sum_{r=1}^{k-1}\ \sum_{s=1}^{k-r} r\binom{k}{r}\binom{k-r}{s} P_1^{\,r} P_3^{\,s} P_2^{\,k-r-s}\right)\left(\sum_{t=1}^{m}\ \sum_{u=o}^{m-t}\binom{m}{t}\binom{m-t}{u} P_1^{\,t} P_3^{\,u} P_2^{\,m-t-u}\right)$$

APPENDIX C:

EFFECT OF ROLE CONFLICT BY CASUALTY PROFILES FOR FIVE GEO-POPULATION AREAS

METROPOLITAN AREA

P2	P3	P1	Degradation Factor	% Difference
.05	.90	.05	74.12	25.88
.05	.85	.10	68.38	31.62
.05	.80	.15	62.99	37.01
.05	.75	.20	57.91	42.09
.05	.70	.25	53.11	46.89
.05	.65	.30	48.56	51.44
.05	.60	.35	44.22	55.78
.05	.55	.40	40.08	59.92
.05	.50	.45	36.09	63.91
.05	.45	.50	32.24	67.76
.05	.40	.55	28.51	71.49
.05	.35	.60	24.86	75.14
.05	.30	.65	21.28	78.72
.05	.25	.70	17.74	82.26
.05	.20	.75	14.23	85.77
.05	.15	.80	10.71	89.29
.05	.10	.85	7.19	92.81
.05	.05	.90	3.62	96.38
.05	.00	.95	0.00	100.00
.10	.85	.05	72.88	27.12
.10	.80	.10	67.11	32.89
.10	.75	.15	61.68	38.32
.10	.70	.20	56.55	43.45
.10	.65	.25	51.69	48.31
.10	.60	.30	47.06	52.94
.10	.55	.35	42.63	57.37
.10	.50	.40	38.38	61.62
.10	.45	.45	34.27	65.73
.10	.40	.50	30.29	69.71
.10	.35	.55	26.40	73.60
.10	.30	.60	22.59	77.41
.10	.25	.65	18.83	81.17
.10	.20	.70	15.10	84.90
.10	.15	.75	11.37	88.63
.10	.10	.80	7.62	92.38
.10	.05	.85	3.84	96.16
.10	.00	.90	0.00	100.00

Metropolitan Area

P2	P3	P1	Degradation Factor	% Difference
.15	.80	.05	71.49	28.51
.15	.75	.10	65.68	34.32
.15	.70	.15	60.20	39.80
.15	.65	.20	55.00	45.00
.15	.60	.25	50.06	49.94
.15	.55	.30	45.34	54.66
.15	.50	.35	40.80	59.20
.15	.45	.40	36.42	63.58
.15	.40	.45	32.18	67.82
.15	.35	.50	28.04	71.96
.15	.30	.55	23.99	76.01
.15	.25	.60	19.98	80.02
.15	.20	.65	16.02	83.98
.15	.15	.70	12.06	87.94
.15	.10	.75	8.08	91.92
.15	.05	.80	4.07	95.93
.15	.00	.85	0.00	100.00
.20	.75	.05	69.93	30.07
.20	.70	.10	64.08	35.92
.20	.65	.15	58.53	41.47
.20	.60	.20	53.25	46.75
.20	.55	.25	48.21	51.79
.20	.50	.30	43.37	56.63
.20	.45	.35	38.70	61.30
.20	.40	.40	34.18	65.82
.20	.35	.45	29.78	70.22
.20	.30	.50	25.46	74.54
.20	.25	.55	21.21	78.79
.20	.20	.60	16.99	83.01
.20	.15	.65	12.79	87.21
.20	.10	.70	8.57	91.43
.20	.05	.75	4.32	95.68
.20	.00	.80	0.00	100.00

Metropolitan Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.25	.70	.05	68.19	31.81
.25	.65	.10	62.27	37.73
.25	.60	.15	56.63	43.37
.25	.55	.20	51.25	48.75
.25	.50	.25	46.10	53.90
.25	.45	.30	41.13	58.87
.25	.40	.35	36.31	63.69
.25	.35	.40	31.62	68.38
.25	.30	.45	27.03	72.97
.25	.25	.50	22.51	77.49
.25	.20	.55	18.03	81.97
.25	.15	.60	13.56	86.44
.25	.10	.65	9.09	90.91
.25	.05	.70	4.58	95.42
.25	.00	.75	0.00	100.00
.30	.65	.05	66.25	33.75
.30	.60	.10	60.23	39.77
.30	.55	.15	54.49	45.51
.30	.50	.20	48.99	51.01
.30	.45	.25	43.70	56.30
.30	.40	.30	38.57	61.43
.30	.35	.35	33.58	66.42
.30	.30	.40	28.69	71.31
.30	.25	.45	23.89	76.11
.30	.20	.50	19.13	80.87
.30	.15	.55	14.39	85.61
.30	.10	.60	9.64	90.36
.30	.05	.65	4.85	95.15
.30	.00	.70	0.00	100.00
.35	.60	.05	64.06	35.94
.35	.55	.10	57.94	42.06
.35	.50	.15	52.07	47.93
.35	.45	.20	46.43	53.57
.35	.40	.25	40.97	59.03
.35	.35	.30	35.66	64.34
.35	.30	.35	30.46	69.54
.35	.25	.40	25.35	74.65
.35	.20	.45	20.30	79.70
.35	.15	.50	15.26	84.74
.35	.10	.55	10.22	89.78
.35	.05	.60	5.15	94.85
.35	.00	.65	0.00	100.00

Metropolitan Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.40	.55	.05	61.60	38.40
.40	.50	.10	55.35	44.65
.40	.45	.15	49.34	50.66
.40	.40	.20	43.52	56.48
.40	.35	.25	37.87	62.13
.40	.30	.30	32.34	67.66
.40	.25	.35	26.91	73.09
.40	.20	.40	21.54	78.46
.40	.15	.45	16.19	83.81
.40	.10	.50	10.84	89.16
.40	.05	.55	5.46	94.54
.40	.00	.60	0.00	100.00
.45	.50	.05	58.84	41.16
.45	.45	.10	52.43	47.57
.45	.40	.15	46.24	53.76
.45	.35	.20	40.22	59.78
.45	.30	.25	34.34	65.66
.45	.25	.30	28.57	71.43
.45	.20	.35	22.86	77.14
.45	.15	.40	17.18	82.82
.45	.10	.45	11.50	88.50
.45	.05	.50	5.79	94.21
.45	.00	.55	0.00	100.00
.50	.45	.05	55.73	44.27
.50	.40	.10	49.13	50.87
.50	.35	.15	42.73	57.27
.50	.30	.20	36.47	63.53
.50	.25	.25	30.33	69.67
.50	.20	.30	24.27	75.73
.50	.15	.35	18.24	81.76
.50	.10	.40	12.21	87.79
.50	.05	.45	6.14	93.86
.50	.00	.50	0.00	100.00
.55	.40	.05	52.22	47.78
.55	.35	.10	45.40	54.60
.55	.30	.15	38.74	61.26
.55	.25	.20	32.21	67.79
.55	.20	.25	25.77	74.23
.55	.15	.30	19.36	80.64
.55	.10	.35	12.96	87.04
.55	.05	.40	6.52	93.48
.55	.00	.45	0.00	100.00

Metropolitan Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.60	.35	.05	48.25	51.75
.60	.30	.10	41.16	58.84
.60	.25	.15	34.22	65.78
.60	.20	.20	27.36	72.64
.60	.15	.25	20.56	79.44
.60	.10	.30	13.76	86.24
.60	.05	.35	6.92	93.08
.60	.00	.40	0.00	100.00
.65	.30	.05	43.75	56.25
.65	.25	.10	36.36	63.64
.65	.20	.15	29.07	70.93
.65	.15	.20	21.83	78.17
.65	.10	.25	14.61	85.39
.65	.05	.30	7.34	92.66
.65	.00	.35	0.00	100.00
.70	.25	.05	38.64	61.36
.70	.20	.10	30.89	69.11
.70	.15	.15	23.20	76.80
.70	.10	.20	15.52	84.48
.70	.05	.25	7.80	92.20
.70	.00	.30	0.00	100.00
.75	.20	.05	32.83	67.17
.75	.15	.10	24.65	75.35
.75	.10	.15	16.49	83.51
.75	.05	.20	8.29	91.71
.75	.00	.25	0.00	100.00
.80	.15	.05	26.21	73.79
.80	.10	.10	17.53	82.47
.80	.05	.15	8.81	91.19
.80	.00	.20	0.00	100.00
.85	.10	.05	18.63	81.37
.85	.05	.10	9.36	90.64
.85	.00	.15	0.00	100.00
.90	.05	.05	9.96	90.04
.90	.00	.10	0.00	100.00
.95	.00	.05	0.00	100.00

URBAN FRINGE AREA

P2	P3	P1	Degradation Factor	% Difference
.05	.90	.05	84.58	15.42
.05	.85	.10	78.22	21.78
.05	.80	.15	72.22	27.78
.05	.75	.20	66.55	33.45
.05	.70	.25	61.18	38.82
.05	.65	.30	56.07	43.93
.05	.60	.35	51.19	48.81
.05	.55	.40	46.50	53.50
.05	.50	.45	41.99	58.01
.05	.45	.50	37.61	62.39
.05	.40	.55	33.34	66.66
.05	.35	.60	29.16	70.84
.05	.30	.65	25.03	74.97
.05	.25	.70	20.94	79.06
.05	.20	.75	16.85	83.15
.05	.15	.80	12.74	87.26
.05	.10	.85	8.57	91.43
.05	.05	.90	4.34	95.66
.05	.00	.95	0.00	100.00
.10	.85	.05	83.34	16.66
.10	.80	.10	76.94	23.06
.10	.75	.15	70.90	29.10
.10	.70	.20	65.17	34.83
.10	.65	.25	59.72	40.28
.10	.60	.30	54.51	45.49
.10	.55	.35	49.51	50.49
.10	.50	.40	44.69	55.31
.10	.45	.45	40.02	59.98
.10	.40	.50	35.48	64.52
.10	.35	.55	31.02	68.98
.10	.30	.60	26.62	73.38
.10	.25	.65	22.26	77.74
.10	.20	.70	17.91	82.09
.10	.15	.75	13.53	86.47
.10	.10	.80	9.11	90.89
.10	.05	.85	4.61	95.39
.10	.00	.90	0.00	100.00

Urban Fringe Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.15	.80	.05	81.93	18.07
.15	.75	.10	75.49	24.51
.15	.70	.15	69.38	30.62
.15	.65	.20	63.57	36.43
.15	.60	.25	58.01	41.99
.15	.55	.30	52.69	47.31
.15	.50	.35	47.55	52.45
.15	.45	.40	42.57	57.43
.15	.40	.45	37.73	62.27
.15	.35	.50	32.98	67.02
.15	.30	.55	28.30	71.70
.15	.25	.60	23.66	76.34
.15	.20	.65	19.02	80.98
.15	.15	.70	14.37	85.63
.15	.10	.75	9.67	90.33
.15	.05	.80	4.89	95.11
.15	.00	.85	0.00	100.00
.20	.75	.05	80.33	19.67
.20	.70	.10	73.83	26.17
.20	.65	.15	67.63	32.37
.20	.60	.20	61.71	38.29
.20	.55	.25	56.04	43.96
.20	.50	.30	50.57	49.43
.20	.45	.35	45.27	54.73
.20	.40	.40	40.10	59.90
.20	.35	.45	35.05	64.95
.20	.30	.50	30.07	69.93
.20	.25	.55	25.13	74.87
.20	.20	.60	20.20	79.80
.20	.15	.65	15.26	84.74
.20	.10	.70	10.26	89.74
.20	.05	.75	5.19	94.81
.20	.00	.80	0.00	100.00

Urban Fringe Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.25	.70	.05	78.52	21.48
.25	.65	.10	71.93	28.07
.25	.60	.15	65.62	34.38
.25	.55	.20	59.58	40.42
.25	.50	.25	53.75	46.25
.25	.45	.30	48.11	51.89
.25	.40	.35	42.61	57.39
.25	.35	.40	37.23	62.77
.25	.30	.45	31.93	68.07
.25	.25	.50	26.68	73.32
.25	.20	.55	21.45	78.55
.25	.15	.60	16.19	83.81
.25	.10	.65	10.89	89.11
.25	.05	.70	5.50	94.50
.25	.00	.75	0.00	100.00
.30	.65	.05	76.47	23.53
.30	.60	.10	69.76	30.24
.30	.55	.15	63.32	36.68
.30	.50	.20	57.12	42.88
.30	.45	.25	51.11	48.89
.30	.40	.30	45.26	54.74
.30	.35	.35	39.54	60.46
.30	.30	.40	33.91	66.09
.30	.25	.45	28.32	71.68
.30	.20	.50	22.76	77.24
.30	.15	.55	17.18	82.82
.30	.10	.60	11.55	88.45
.30	.05	.65	5.84	94.16
.30	.00	.70	0.00	100.00
.35	.60	.05	74.12	25.88
.35	.55	.10	67.27	32.73
.35	.50	.15	60.67	39.33
.35	.45	.20	54.28	45.72
.35	.40	.25	48.07	51.93
.35	.35	.30	41.98	58.02
.35	.30	.35	35.99	64.01
.35	.25	.40	30.06	69.94
.35	.20	.45	24.15	75.85
.35	.15	.50	18.23	81.77
.35	.10	.55	12.25	87.75
.35	.05	.60	6.19	93.81
.35	.00	.65	0.00	100.00

Urban Fringe Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.40	.55	.05	71.45	28.55
.40	.50	.10	64.43	35.57
.40	.45	.15	57.64	42.36
.40	.40	.20	51.03	48.97
.40	.35	.25	44.56	55.44
.40	.30	.30	38.19	61.81
.40	.25	.35	31.89	68.11
.40	.20	.40	25.62	74.38
.40	.15	.45	19.33	80.67
.40	.10	.50	12.99	87.01
.40	.05	.55	6.56	93.44
.40	.00	.60	0.00	100.00
.45	.50	.05	68.41	31.59
.45	.45	.10	61.19	38.81
.45	.40	.15	54.16	45.84
.45	.35	.20	47.29	52.71
.45	.30	.25	40.52	59.48
.45	.25	.30	33.83	66.17
.45	.20	.35	27.17	72.83
.45	.15	.40	20.50	79.50
.45	.10	.45	13.78	86.22
.45	.05	.50	6.96	93.04
.45	.00	.55	0.00	100.00
.50	.45	.05	64.94	35.06
.50	.40	.10	57.47	42.53
.50	.35	.15	50.17	49.83
.50	.30	.20	42.99	57.01
.50	.25	.25	35.89	64.11
.50	.20	.30	28.82	71.18
.50	.15	.35	21.74	78.26
.50	.10	.40	14.60	85.40
.50	.05	.45	7.37	92.63
.50	.00	.50	0.00	100.00
.55	.40	.05	60.98	39.02
.55	.35	.10	53.22	46.78
.55	.30	.15	45.60	54.40
.55	.25	.20	38.06	61.94
.55	.20	.25	30.55	69.45
.55	.15	.30	23.04	76.96
.55	.10	.35	15.48	84.52
.55	.05	.40	7.81	92.19
.55	.00	.45	0.00	100.00

Urban Fringe Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.60	.35	.05	56.46	43.54
.60	.30	.10	48.36	51.64
.60	.25	.15	40.36	59.64
.60	.20	.20	32.40	67.60
.60	.15	.25	24.43	75.57
.60	.10	.30	16.41	83.59
.60	.05	.35	8.28	91.72
.60	.00	.40	0.00	100.00
.65	.30	.05	51.29	48.71
.65	.25	.10	42.79	57.21
.65	.20	.15	34.35	65.65
.65	.15	.20	25.90	74.10
.65	.10	.25	17.39	82.61
.65	.05	.30	8.78	91.22
.65	.00	.35	0.00	100.00
.70	.25	.05	45.37	54.63
.70	.20	.10	36.41	63.59
.70	.15	.15	27.45	72.55
.70	.10	.20	18.43	81.57
.70	.05	.25	9.30	90.70
.70	.00	.30	0.00	100.00
.75	.20	.05	38.60	61.40
.75	.15	.10	29.10	70.90
.75	.10	.15	19.53	80.47
.75	.05	.20	9.86	90.14
.75	.00	.25	0.00	100.00
.80	.15	.05	30.84	69.16
.80	.10	.10	20.70	79.30
.80	.05	.15	10.45	89.55
.80	.00	.20	0.00	100.00
.85	.10	.05	21.94	78.06
.85	.05	.10	11.07	88.93
.85	.00	.15	0.00	100.00
.90	.05	.05	11.73	88.27
.90	.00	.10	0.00	100.00
.95	.00	.05	0.00	100.00

INDEPENDENT CITY

P2	P3	P1	Degradation Factor	% Difference
.05	.90	.05	80.19	19.81
.05	.85	.10	74.08	25.92
.05	.80	.15	68.34	31.66
.05	.75	.20	62.92	37.08
.05	.70	.25	57.78	42.22
.05	.65	.30	52.90	47.10
.05	.60	.35	48.25	51.75
.05	.55	.40	43.78	56.22
.05	.50	.45	39.48	60.52
.05	.45	.50	35.32	64.68
.05	.40	.55	31.27	68.73
.05	.35	.60	27.30	72.70
.05	.30	.65	23.40	76.60
.05	.25	.70	19.54	80.46
.05	.20	.75	15.69	84.31
.05	.15	.80	11.84	88.16
.05	.10	.85	7.95	92.05
.05	.05	.90	4.02	95.98
.05	.00	.95	0.00	100.00
.10	.85	.05	78.81	21.19
.10	.80	.10	72.68	27.32
.10	.75	.15	66.90	33.10
.10	.70	.20	61.42	38.58
.10	.65	.25	56.22	43.78
.10	.60	.30	51.25	48.75
.10	.55	.35	46.49	53.51
.10	.50	.40	41.92	58.08
.10	.45	.45	37.48	62.52
.10	.40	.50	33.18	66.82
.10	.35	.55	28.96	71.04
.10	.30	.60	24.82	75.18
.10	.25	.65	20.71	79.29
.10	.20	.70	16.63	83.37
.10	.15	.75	12.54	87.46
.10	.10	.80	8.42	91.58
.10	.05	.85	4.25	95.75
.10	.00	.90	0.00	100.00

Independent City (continued)

P2	P3	P1	Degradation Factor	% Difference
.15	.80	.05	77.28	22.72
.15	.75	.10	71.11	28.89
.15	.70	.15	65.27	34.73
.15	.65	.20	59.72	40.28
.15	.60	.25	54.43	45.57
.15	.55	.30	49.37	50.63
.15	.50	.35	44.49	55.51
.15	.45	.40	39.78	60.22
.15	.40	.45	35.19	64.81
.15	.35	.50	30.71	69.29
.15	.30	.55	26.31	73.69
.15	.25	.60	21.95	78.05
.15	.20	.65	17.62	82.38
.15	.15	.70	13.29	86.71
.15	.10	.75	8.92	91.08
.15	.05	.80	4.50	95.50
.15	.00	.85	0.00	100.00
.20	.75	.05	75.58	24.42
.20	.70	.10	69.36	30.64
.20	.65	.15	63.44	36.56
.20	.60	.20	57.81	42.19
.20	.55	.25	52.41	47.59
.20	.50	.30	47.22	52.78
.20	.45	.35	42.21	57.79
.20	.40	.40	37.33	62.67
.20	.35	.45	32.57	67.43
.20	.30	.50	27.89	72.11
.20	.25	.55	23.27	76.73
.20	.20	.60	18.67	81.33
.20	.15	.65	14.08	85.92
.20	.10	.70	9.45	90.55
.20	.05	.75	4.77	95.23
.20	.00	.80	0.00	100.00

Independent City (continued)

P2	P3	P1	Degradation Factor	% Difference
.25	.70	.05	73.69	26.31
.25	.65	.10	67.39	32.61
.25	.60	.15	61.39	38.61
.25	.55	.20	55.64	44.36
.25	.50	.25	50.12	49.88
.25	.45	.30	44.78	55.22
.25	.40	.35	39.60	60.40
.25	.35	.40	34.54	65.46
.25	.30	.45	29.57	70.43
.25	.25	.50	24.66	75.34
.25	.20	.55	19.79	80.21
.25	.15	.60	14.91	85.09
.25	.10	.65	10.01	89.99
.25	.05	.70	5.05	94.95
.25	.00	.75	0.00	100.00
.30	.65	.05	71.58	28.42
.30	.60	.10	65.18	34.82
.30	.55	.15	59.07	40.93
.30	.50	.20	53.19	46.81
.30	.45	.25	47.51	52.49
.30	.40	.30	42.00	58.00
.30	.35	.35	36.62	63.38
.30	.30	.40	31.35	68.65
.30	.25	.45	26.14	73.86
.30	.20	.50	20.97	79.03
.30	.15	.55	15.80	84.20
.30	.10	.60	10.60	89.40
.30	.05	.65	5.35	94.65
.30	.00	.70	0.00	100.00
.35	.60	.05	69.21	30.79
.35	.55	.10	62.70	37.30
.35	.50	.15	56.45	43.55
.35	.45	.20	50.41	49.59
.35	.40	.25	44.55	55.45
.35	.35	.30	38.84	61.16
.35	.30	.35	33.23	66.77
.35	.25	.40	27.71	72.29
.35	.20	.45	22.22	77.78
.35	.15	.50	16.74	83.26
.35	.10	.55	11.23	88.77
.35	.05	.60	5.66	94.34
.35	.00	.65	0.00	100.00

Independent City (continued)

P2	P3	P1	Degradation Factor	% Difference
.40	.55	.05	66.56	33.44
.40	.50	.10	59.91	40.09
.40	.45	.15	53.49	46.51
.40	.40	.20	47.26	52.74
.40	.35	.25	41.19	58.81
.40	.30	.30	35.24	64.76
.40	.25	.35	29.37	70.63
.40	.20	.40	23.55	76.45
.40	.15	.45	17.73	82.27
.40	.10	.50	11.90	88.10
.40	.05	.55	6.00	94.00
.40	.00	.60	0.00	100.00
.45	.50	.05	63.58	36.42
.45	.45	.10	56.75	43.25
.45	.40	.15	50.14	49.86
.45	.35	.20	43.69	56.31
.45	.30	.25	37.37	62.63
.45	.25	.30	31.14	68.86
.45	.20	.35	24.96	75.04
.45	.15	.40	18.79	81.21
.45	.10	.45	12.60	87.40
.45	.05	.50	6.35	93.65
.45	.00	.55	0.00	100.00
.50	.45	.05	60.23	39.77
.50	.40	.10	53.19	46.81
.50	.35	.15	46.34	53.66
.50	.30	.20	39.63	60.37
.50	.25	.25	33.01	66.99
.50	.20	.30	26.46	73.54
.50	.15	.35	19.92	80.08
.50	.10	.40	13.36	86.64
.50	.05	.45	6.73	93.27
.50	.00	.50	0.00	100.00
.55	.40	.05	56.45	43.55
.55	.35	.10	49.16	50.84
.55	.30	.15	42.03	57.97
.55	.25	.20	35.01	64.99
.55	.20	.25	28.05	71.95
.55	.15	.30	21.12	78.88
.55	.10	.35	14.16	85.84
.55	.05	.40	7.13	92.87
.55	.00	.45	0.00	100.00

Independent City (continued)

P2	P3	P1	Degradation Factor	% Difference
.60	.35	.05	52.17	47.83
.60	.30	.10	44.59	55.41
.60	.25	.15	37.13	62.87
.60	.20	.20	29.75	70.25
.60	.15	.25	22.39	77.61
.60	.10	.30	15.01	84.99
.60	.05	.35	7.56	92.44
.60	.00	.40	0.00	100.00
.65	.30	.05	47.32	52.68
.65	.25	.10	39.40	60.60
.65	.20	.15	31.56	68.44
.65	.15	.20	23.75	76.25
.65	.10	.25	15.92	84.08
.65	.05	.30	8.02	91.98
.65	.00	.35	0.00	100.00
.70	.25	.05	41.81	58.19
.70	.20	.10	33.48	66.52
.70	.15	.15	25.19	74.81
.70	.10	.20	16.88	83.12
.70	.05	.25	8.50	91.50
.70	.00	.30	0.00	100.00
.75	.20	.05	35.53	64.47
.75	.15	.10	26.73	73.27
.75	.10	.15	17.91	82.09
.75	.05	.20	9.02	90.98
.75	.00	.25	0.00	100.00
.80	.15	.05	28.37	71.63
.80	.10	.10	19.01	80.99
.80	.05	.15	9.57	90.43
.80	.00	.20	0.00	100.00
.85	.10	.05	20.18	79.82
.85	.05	.10	10.16	89.84
.85	.00	.15	0.00	100.00
.90	.05	.05	10.79	89.21
.90	.00	.10	0.00	100.00
.95	.00	.05	0.00	100.00

RURAL NON-FARM AREA

P2	P3	P1	Degradation Factor	% Difference
.05	.90	.05	89.54	10.46
.05	.85	.10	82.14	17.86
.05	.80	.15	75.27	24.73
.05	.75	.20	68.86	31.14
.05	.70	.25	62.88	37.12
.05	.65	.30	57.26	42.74
.05	.60	.35	51.96	48.04
.05	.55	.40	46.95	53.05
.05	.50	.45	42.17	57.83
.05	.45	.50	37.59	62.41
.05	.40	.55	33.18	66.82
.05	.35	.60	28.90	71.10
.05	.30	.65	24.72	75.28
.05	.25	.70	20.61	79.39
.05	.20	.75	16.53	83.47
.05	.15	.80	12.46	87.54
.05	.10	.85	8.37	91.63
.05	.05	.90	4.22	95.78
.05	.00	.95	0.00	100.00
.10	.85	.05	88.21	11.79
.10	.80	.10	80.80	19.20
.10	.75	.15	73.90	26.10
.10	.70	.20	67.45	32.55
.10	.65	.25	61.40	38.60
.10	.60	.30	55.69	44.31
.10	.55	.35	50.29	49.71
.10	.50	.40	45.16	54.84
.10	.45	.45	40.24	59.76
.10	.40	.50	35.50	64.50
.10	.35	.55	30.91	69.09
.10	.30	.60	26.42	73.58
.10	.25	.65	22.02	77.98
.10	.20	.70	17.65	82.35
.10	.15	.75	13.30	86.70
.10	.10	.80	8.93	91.07
.10	.05	.85	4.51	95.49
.10	.00	.90	0.00	100.00

Rural Non-Farm Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.15	.80	.05	86.71	13.29
.15	.75	.10	79.28	20.72
.15	.70	.15	72.33	27.67
.15	.65	.20	65.81	34.19
.15	.60	.25	59.68	40.32
.15	.55	.30	53.87	46.13
.15	.50	.35	48.34	51.66
.15	.45	.40	43.06	56.94
.15	.40	.45	37.97	62.03
.15	.35	.50	33.05	66.95
.15	.30	.55	28.24	71.76
.15	.25	.60	23.52	76.48
.15	.20	.65	18.85	81.15
.15	.15	.70	14.20	85.80
.15	.10	.75	9.53	90.47
.15	.05	.80	4.81	95.19
.15	.00	.85	0.00	100.00
.20	.75	.05	85.03	14.97
.20	.70	.10	77.55	22.45
.20	.65	.15	70.54	29.46
.20	.60	.20	63.94	36.06
.20	.55	.25	57.69	42.31
.20	.50	.30	51.75	48.25
.20	.45	.35	46.08	53.92
.20	.40	.40	40.62	59.38
.20	.35	.45	35.33	64.67
.20	.30	.50	30.18	69.82
.20	.25	.55	25.13	74.87
.20	.20	.60	20.13	79.87
.20	.15	.65	15.16	84.84
.20	.10	.70	10.17	89.83
.20	.05	.75	5.13	94.87
.20	.00	.80	0.00	100.00

Rural Non-Farm Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.25	.70	.05	83.14	16.86
.25	.65	.10	75.60	24.40
.25	.60	.15	68.49	31.51
.25	.55	.20	61.78	38.22
.25	.50	.25	55.40	44.60
.25	.45	.30	49.30	50.70
.25	.40	.35	43.44	56.56
.25	.35	.40	37.78	62.22
.25	.30	.45	32.26	67.74
.25	.25	.50	26.85	73.15
.25	.20	.55	21.50	78.50
.25	.15	.60	16.19	83.81
.25	.10	.65	10.86	89.14
.25	.05	.70	5.47	94.53
.25	.00	.75	0.00	100.00
.30	.65	.05	81.01	18.99
.30	.60	.10	73.37	26.63
.30	.55	.15	66.16	33.84
.30	.50	.20	59.30	40.70
.30	.45	.25	52.76	47.24
.30	.40	.30	46.47	53.53
.30	.35	.35	40.39	59.61
.30	.30	.40	34.48	65.52
.30	.25	.45	28.69	71.31
.30	.20	.50	22.97	77.03
.30	.15	.55	17.28	82.72
.30	.10	.60	11.59	88.41
.30	.05	.65	5.84	94.16
.30	.00	.70	0.00	100.00
.35	.60	.05	78.60	21.40
.35	.55	.10	70.84	29.16
.35	.50	.15	63.48	36.52
.35	.45	.20	56.45	43.55
.35	.40	.25	49.71	50.29
.35	.35	.30	43.19	56.81
.35	.30	.35	36.86	63.14
.35	.25	.40	30.65	69.35
.35	.20	.45	24.54	75.46
.35	.15	.50	18.46	81.54
.35	.10	.55	12.37	87.63
.35	.05	.60	6.23	93.77
.35	.00	.65	0.00	100.00

Rural Non-Farm Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.40	.55	.05	75.87	24.13
.40	.50	.10	67.96	32.04
.40	.45	.15	60.41	39.59
.40	.40	.20	53.18	46.82
.40	.35	.25	46.19	53.81
.40	.30	.30	39.40	60.60
.40	.25	.35	32.76	67.24
.40	.20	.40	26.22	73.78
.40	.15	.45	19.72	80.28
.40	.10	.50	13.21	86.79
.40	.05	.55	6.66	93.34
.40	.00	.60	0.00	100.00
.45	.50	.05	72.76	27.24
.45	.45	.10	64.66	35.34
.45	.40	.15	56.90	43.10
.45	.35	.20	49.41	50.59
.45	.30	.25	42.14	57.86
.45	.25	.30	35.02	64.98
.45	.20	.35	28.02	71.98
.45	.15	.40	21.06	78.94
.45	.10	.45	14.11	85.89
.45	.05	.50	7.11	92.89
.45	.00	.55	0.00	100.00
.50	.45	.05	69.22	30.78
.50	.40	.10	60.89	39.11
.50	.35	.15	52.86	47.14
.50	.30	.20	45.06	54.94
.50	.25	.25	37.45	62.55
.50	.20	.30	29.95	70.05
.50	.15	.35	22.51	77.49
.50	.10	.40	15.08	84.92
.50	.05	.45	7.59	92.41
.50	.00	.50	0.00	100.00
.55	.40	.05	65.18	34.82
.55	.35	.10	56.56	43.44
.55	.30	.15	48.21	51.79
.55	.25	.20	40.05	59.95
.55	.20	.25	32.02	67.98
.55	.15	.30	24.06	75.94
.55	.10	.35	16.11	83.89
.55	.05	.40	8.11	91.89
.55	.00	.45	0.00	100.00

Rural Non-Farm Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.60	.35	.05	60.54	39.46
.60	.30	.10	51.59	48.41
.60	.25	.15	42.84	57.16
.60	.20	.20	34.25	65.75
.60	.15	.25	25.73	74.27
.60	.10	.30	17.23	82.77
.60	.05	.35	8.67	91.33
.60	.00	.40	0.00	100.00
.65	.30	.05	55.22	44.78
.65	.25	.10	45.85	54.15
.65	.20	.15	36.64	63.36
.65	.15	.20	27.52	72.48
.65	.10	.25	18.42	81.58
.65	.05	.30	9.27	90.73
.65	.00	.35	0.00	100.00
.70	.25	.05	49.08	50.92
.70	.20	.10	39.21	60.79
.70	.15	.15	29.45	70.55
.70	.10	.20	19.71	80.29
.70	.05	.25	9.92	90.08
.70	.00	.30	0.00	100.00
.75	.20	.05	41.98	58.02
.75	.15	.10	31.52	68.48
.75	.10	.15	21.09	78.91
.75	.05	.20	10.61	89.39
.75	.00	.25	0.00	100.00
.80	.15	.05	33.75	66.25
.80	.10	.10	22.58	77.42
.80	.05	.15	11.36	88.64
.80	.00	.20	0.00	100.00
.85	.10	.05	24.18	75.82
.85	.05	.10	12.16	87.84
.85	.00	.15	0.00	100.00
.90	.05	.05	13.03	86.97
.90	.00	.10	0.00	100.00
.95	.00	.10	0.00	100.00

RURAL FARM AREA

P2	P3	P1	Degradation Factor	% Difference
.05	.90	.05	87.30	12.70
.05	.85	.10	79.64	20.36
.05	.80	.15	72.60	27.40
.05	.75	.20	66.10	33.90
.05	.70	.25	60.08	39.92
.05	.65	.30	54.48	45.52
.05	.60	.35	49.25	50.75
.05	.55	.40	44.33	55.67
.05	.50	.45	39.69	60.31
.05	.45	.50	35.28	64.72
.05	.40	.55	31.05	68.95
.05.	.35	.60	26.98	73.02
.05	.30	.65	23.03	76.97
.05	.25	.70	19.16	80.84
.05	.20	.75	15.35	84.65
.05	.15	.80	11.55	88.45
.05	.10	.85	7.75	92.25
.05	.05	.90	3.91	96.09
.05	.00	.95	0.00	100.00
.10	.85	.05	86.01	13.99
.10	.80	.10	78.36	21.64
.10	.75	.15	71.30	28.70
.10	.70	.20	64.77	35.23
.10	.65	.25	58.69	41.31
.10	.60	.30	53.02	46.98
.10	.55	.35	47.70	52.30
.10	.50	.40	42.68	57.32
.10	.45	.45	37.91	62.09
.10	.40	.50	33.35	66.65
.10	.35	.55	28.96	71.04
.10	.30	.60	24.70	75.30
.10	.25	.65	20.54	79.46
.10	.20	.70	16.44	83.56
.10	.15	.75	12.37	87.63
.10	.10	.80	8.30	91.70
.10	.05	.85	4.18	95.82
.10	.00	.90	0.00	100.00

Rural Farm Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.15	.80	.05	84.57	15.43
.15	.75	.10	76.91	23.09
.15	.70	.15	69.82	30.18
.15	.65	.20	63.23	36.77
15	.60	.25	57.09	42.91
.15	.55	.30	51.33	48.67
.15	.50	.35	45.89	54.11
.15	.45	.40	40.74	59.26
.15	.40	.45	35.82	64.18
.15	.35	.50	31.09	68.91
.15	.30	.55	26.50	73.50
.15	.25	.60	22.03	77.97
.15	.20	.65	17.62	82.38
.15	.15	.70	13.25	86.75
.15	.10	.75	8.88	91.12
.15	.05	.80	4.48	95.52
.15	.00	.85	0.00	100.00
.20	.75	.05	82.96	17.04
.20	.70	.10	75.27	24.73
.20	.65	.15	68.13	31.87
.20	.60	.20	61.48	38.52
.20	.55	.25	55.24	44.76
.20	.50	.30	49.36	50.64
.20	.45	.35	43.79	56.21
.20	.40	.40	38.48	61.52
.20	.35	.45	33.38	66.62
.20	.30	.50	28.44	71.56
.20	.25	.55	23.63	76.37
.20	.20	.60	18.89	81.11
.20	.15	.65	14.20	85.80
.20	.10	.70	9.51	90.49
.20	.05	.75	4.79	95.21
.20	.00	.80	0.00	100.00

Rural Farm Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.25	.70	.05	81.16	18.84
.25	.65	.10	73.42	26.58
.25	.60	.15	66.21	33.79
.25	.55	.20	59.46	40.54
.25	.50	.25	53.10	46.90
.25	.45	.30	47.08	52.92
.25	.40	.35	41.35	58.65
.25	.35	.40	35.85	64.15
.25	.30	.45	30.53	69.47
.25	.25	.50	25.35	74.65
.25	.20	.55	20.26	79.74
.25	.15	.60	15.22	84.78
.25	.10	.65	10.20	89.80
.25	.05	.70	5.13	94.87
.25	.00	.75	0.00	100.00
.30	.65	.05	79.13	20.87
.30	.60	.10	71.32	28.68
.30	.55	.15	64.01	35.99
.30	.50	.20	57.14	42.86
.30	.45	.25	50.64	49.36
.30	.40	.30	44.45	55.55
.30	.35	.35	38.51	61.49
.30	.30	.40	32.78	67.22
.30	.25	.45	27.21	72.79
.30	.20	.50	21.74	78.26
.30	.15	.55	16.33	83.67
.30	.10	.60	10.93	89.07
.30	.05	.65	5.50	94.50
.30	.00	.70	0.00	100.00
.35	.60	.05	76.84	23.16
.35	.55	.10	68.94	31.06
.35	.50	.15	61.50	38.50
.35	.45	.20	54.48	45.52
.35	.40	.25	47.79	52.21
.35	.35	.30	41.39	58.61
.35	.30	.35	35.22	64.78
.35	.25	.40	29.21	70.79
.35	.20	.45	23.33	76.67
.35	.15	.50	17.52	82.48
.35	.10	.55	11.72	88.28
.35	.05	.60	5.90	94.10
.35	.00	.65	0.00	100.00

Rural Farm Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.40	.55	.05	74.26	25.74
.40	.50	.10	66.22	33.78
.40	.45	.15	58.63	41.37
.40	.40	.20	51.41	48.59
.40	.35	.25	44.50	55.50
.40	.30	.30	37.85	62.15
.40	.25	.35	31.38	68.62
.40	.20	.40	25.05	74.95
.40	.15	.45	18.80	81.20
.40	.10	.50	12.58	87.42
.40	.05	.55	6.33	93.67
.40	.00	.60	0.00	100.00
.45	.50	.05	71.33	28.67
.45	.45	.10	63.12	36.88
.45	.40	.15	55.32	44.68
.45	.35	.20	47.87	52.13
.45	.30	.25	40.69	59.31
.45	.25	.30	33.73	66.27
.45	.20	.35	26.92	73.08
.45	.15	.40	20.20	79.80
.45	.10	.45	13.51	86.49
.45	.05	.50	6.80	93.20
.45	.00	.55	0.00	100.00
.50	.45	.05	67.98	32.02
.50	.40	.10	59.56	40.44
.50	.35	.15	51.52	48.48
.50	.30	.20	43.78	56.22
.50	.25	.25	36.27	63.73
.50	.20	.30	28.94	71.06
.50	.15	.35	21.70	78.30
.50	.10	.40	14.51	85.49
.50	.05	.45	7.30	92.70
.50	.00	.50	0.00	100.00
.55	.40	.05	64.15	35.85
.55	.35	.10	55.46	44.54
.55	.30	.15	47.12	52.88
.55	.25	.20	39.02	60.98
.55	.20	.25	31.12	68.88
.55	.15	.30	23.34	76.66
.55	.10	.35	15.60	84.40
.55	.05	.40	7.84	92.16
.55	.00	.45	0.00	100.00

Rural Farm Area (continued)

P2	P3	P1	Degradation Factor	% Difference
.60	.35	.05	59.74	40.26
.60	.30	.10	50.73	49.27
.60	.25	.15	42.01	57.99
.60	.20	.20	33.49	66.51
.60	.15	.25	25.11	74.89
.60	.10	.30	16.78	83.22
.60	.05	.35	8.43	91.57
.60	.00	.40	0.00	100.00
.65	.30	.05	54.66	45.34
.65	.25	.10	45.24	54.76
.65	.20	.15	36.06	63.94
.65	.15	.20	27.02	72.98
.65	.10	.25	18.06	81.94
.65	.05	.30	9.07	90.93
.65	.00	.35	0.00	100.00
.70	.25	.05	48.75	51.25
.70	.20	.10	38.85	61.15
.70	.15	.15	29.11	70.89
.70	.10	.20	19.44	80.56
.70	.05	.25	9.77	90.23
.70	.00	.30	0.00	100.00
.75	.20	.05	41.87	58.13
.75	.15	.10	31.36	68.64
.75	.10	.15	20.95	79.05
.75	.05	.20	10.52	89.48
.75	.00	.25	0.00	100.00
.80	.15	.05	33.81	66.19
.80	.10	.10	22.58	77.42
.80	.05	.15	11.34	88.66
.80	.00	.20	0.00	100.00
.85	.10	.05	24.35	75.65
.85	.05	.10	12.23	87.77
.85	.00	.15	0.00	100.00
.90	.05	.05	13.19	86.81
.90	.00	.10	0.00	100.00
.95	.00	.05	0.00	100.00

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13. ABSTRACT The purpose of this study was (1) to demonstrate the practical importance of considering behavioral factors in post-nuclear attack planning and (2) to develop a means for considering them. The project involved taking one behavioral factor--the conflict which could arise between an individual's need to provide care for an injured family member and society's need for him to return to work--and estimating its impact on one area of post-attack planning: predictions of available labor following a disaster. Formulas were developed and applied across five different types of population areas for 190 types of population damage, through several time phases; in all, 950 separate computer analyses were made. The results of the study are that, first of all, it was possible to incorporate this behavioral factor into post-attack planning, and secondly, there was demonstrable impact as a result: the available labor figure projected without considering this behavioral factor was in general at least 15% greater than that derived with such consideration throughout the first 85 days following attack, and in some instances was overestimated by a factor of four. We believe that the results indicate that the method developed has provided a means of putting behavioral factors into a form which allows them to become a part of damage assessment procedures, to trace out systematically their effects, under a variety of assumptions about the attack itself and the pre-attack situation. The method has value as a prototype for tools which can examine these effects to better determine their relative importance to post-attack planning.

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Nuclear-Attack Effects						
Damage Assessment						

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